D1.1 Requirements from Demo Cases

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Executive summary

Fiware4Water intends to link the water sector to the FIWARE smart solution platform by demonstrating its capabilities and the potential of its interoperable and standardised interfaces for both water sector end-users (cities, water utilities, water authorities, citizens and consumers), and solution providers (private utilities, SMEs, developers). From the outset of the project it is important to understand, identify and describe the use cases of the FIWARE-compliant Smart Water Applications that are to be developed, aiming to address the challenges identified at the four demo cases studied.

This deliverable documents the activities conducted within Task 1.1 concerning the identification of the current state-of-play of the legacy systems and the articulation of the relevant use cases and system requirements of the FIWARE-compliant Smart Water Applications for each Demo Case. This is implemented through 3 workshops organised at each demo case between local utility and local research partner to analyse the key existing technologies used in each case, the needs stem from the new sensors deployed and smart applications to be developed and the challenges that utility want to address.

The document presents the final lists of use cases and system requirements for the FIWARE-compliant Smart Water Applications as established after the completion of workshops at each demo case. These lists determine the subsequent activities in the project and informs directly the design of the Fiware4Water system architecture (WP2) and the development of Smart Applications (WP3).

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List of Acronyms/Glossary

AMR	Automatic Meter Reading
F4W	Fiware4Water project (https:/www.fiware4water.eu/)
FIWARE	Curated framework of open source platform components to accelerate the development of Smart Solutions (https://www.fiware.org/)
N/A	Not available
NGI	Next Generation Internet *The Next Generation Internet (NGI) initiative, launched by the European Commission in the autumn of 2016, aims to shape the future internet as an interoperable platform ecosystem that embodies the values that Europe holds dear: openness, inclusivity, transparency, privacy, cooperation, and protection of data.*
PID controller	Proportional–Integral–Derivative controller
SCADA	Supervisory Control And Data Acquisition
Sluice gate	Movable gate controlling water levels and flow rates
SME	Small and Medium Enterprises
UML	Unified Modelling Language
User story	An informal, natural language description of one or more features of a software system
PO	Process operators
PT	Process technologist
Hydraulic Transient	A planned or accidental change of conditions in a water distribution network, e.g. by opening or closing a pump or valve.
WPL	Work Packages Leaders
WWTP	Wastewater Treatment Plant

I. Introduction

Fiware4Water (F4W) intends to link the water sector to the FIWARE smart solution platform by demonstrating its capabilities and the potential of its interoperable and standardised interfaces for both water sector end-users (cities, water utilities, water authorities, citizens and consumers), and solution providers (private utilities, SMEs, developers).

Towards this, we will develop water-related Smart Applications using FIWARE platform and open API architecture. The developed applications will cover a wide range of water challenges and contexts and will be demonstrated in 4 large-scale and complementary Demo Cases throughout Europe: Raw Water Supply (Athens/Greece), Water Distribution (Cannes/France), Wastewater Treatment (Amsterdam/Netherlands) and Smart Meters with Citizen Engagement (Great Torrington/United Kingdom). For each one, the FIWARE-compliant solution will be seamlessly integrated with the legacy system taking advantage of existing data, sensors, models and simulators, improving long standing tools (e.g., EPANET) and introducing new (smart) ones.

This deliverable D1.1, entitled as “Requirements from Demo Cases”, presents the findings of Task 1.1 that aims to identify the current state-of-play of the legacy systems and the relevant use cases and system requirements of the FIWARE-compliant Smart Water Applications that address the relevant challenges at each Demo Case. The use cases and system requirements identified inform the design of the Fiware4Water system architecture (WP2) and the development of Smart Applications (WP3).

This document first provides an overview of the key characteristics of the four Demo Cases studied along with the corresponding water-related challenges that are to be addressed by the FIWARE-compliant Smart Water Applications (see Section II). The common approach that was followed for the articulation and description of use cases in all four demo cases is presented in Section III. Section IV provides the high-level use cases (user stories) at each demo case, while the detailed-level use cases (herein after termed as ‘use cases’) are presented in Section V. The system requirements that derive on the basis of use cases identified, are presented in Section VI. Finally, Section VIII summarises the findings of this deliverable.

II. Description of Demo Cases

II.1. Demo Case #1. Athens (Greece)

Table 1: Summary of Demo Case #1. Athens

Case #1: GR	**Owner: Athens Water Supply and Sewerage Company (EYDAP)**
Water Domain	Water resources and raw water supply
Existing Situation	SCADA, empirical tools, offline databases
Data Sources	Flow meters, water quality sensors
Fiware4Water Apps	Optimal conveyance scheduling; Early Warning for Water Quality
Objectives	Increase efficiency, decrease loss of resources, decrease treatment issues

Athens Water Supply and Sewerage Company (EYDAP S.A.), is the largest company of its kind in Greece and serves approximately 4,400,000 customers (2,160,000 water meters) while the length of water pipelines is 14,000 km. The sewerage sector serves 3,500,000 residents with sewers spreading at almost 9,500 km. The Company’s main objects is to provide water supply and sewerage services and to design, construct, install, operate, manage, maintain, expand and upgrade water supply and sewerage systems.

EYDAP uses raw water mainly from surface water resources:

- Marathonas (maximum capacity: 41 million m^3, operation capacity: 34 million m^3),
- Yliki (maximum capacity: 590 million m^3, operation capacity: 580 million m^3),
- Mornos (maximum capacity: 764 million m^3, operation capacity: 630 million m^3),
- Evinos (maximum capacity: 138 million m^3, operation capacity: 113 million m^3)

Additionally, the Company's water sources also include underground water resources which are exploited by 100 boreholes.

The transfer of raw water sources (reservoirs and boreholes) to the Water Treatment Plants (WTP) of Attica is accomplished via an extensive external aqueduct system with total length 495km. The schematic representation of the external water supply system of EYDAP, along with all the constructions, is given in Figure 1.

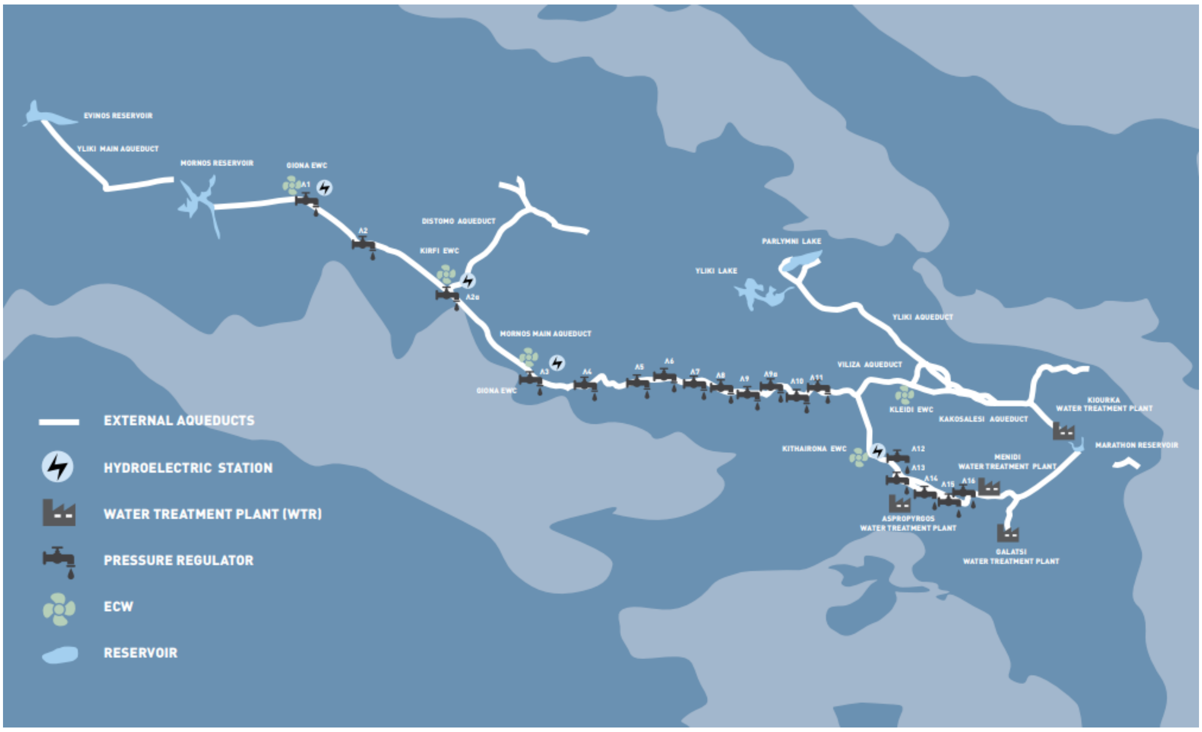

Figure 1: Schematic representation of the external water supply system of EYDAP

The Evinos reservoir communicates with the Mornos reservoir through the Evinos – Mornos Tunnel. Water from the Evinos Reservoir is transported and channeled to the Mornos reservoir to boost water reserves. The operation of the Tunnel is under pressure to provide 27 m^3/s of water. The Evinos-Mornos tunnel has a total length of 29.4 m and inner diameter of 3.5 m. The construction of the tunnel started in 1992 and completed in 2 years. It is one of the longest hydraulic tunnels in the world constructed using advanced tunnel boring technology.

The aqueducts are divided into:

- Main (Mornos, Yliki) with a total length of 310 km
- Connecting (Mornos-Yliki, Marathonas-Galatsi, Distomo) with a total length of 105 km
- Auxiliary, with a total length of 80 km

The aqueducts of Mornos and Yliki communicate with each other via connecting aqueducts. The existence of connecting aqueducts allows control and maintenance of the two aqueducts, with the option of closure of one of the two. In addition, it provides the option of alternative modes of exploitation of water resources, depending on the hydrological conditions and consumption needs. The Yliki Aqueduct has a total length of 67 km and works with pumping. Water from the Mornos reservoir is carried to Athens via a gravity conveyance system with a total length of 188 km. The daily capacity of Mornos to Thiva aqueduct is 23 m^3/s and it splits on the 146th km in the Kethairon division. After the division, the main branch has a capacity of 11.5 m^3/s and a length of 43 km and it goes to Athens. The other branch meets with the Yliki aqueduct, which has a capacity of 4.2 m^3/s and a length of 17.85 km.

Despite the long distance of the main water sources from Attica, the largest amount of water is being carried via gravity without the financial and environmental burden that the energy-intensive pumps cause, which are activated only in case of emergency.

Constant monitoring the external aqueduct system operation is crucial for EYDAP, in order to ensure and certify the excellent quality of water and services provided to the citizens of Athens. For this reason, daily quality control tests of the raw water are conducted, with cutting edge analysis methods in the chemical and microbiological laboratories of EYDAP.

In addition, state-of-the-art systems for the on-line monitoring of critical qualitative parameters have been installed at crucial positions at the external aqueducts, that send real-time results, with the use of telemetry and timely notifications in case of extreme rates.

To ensure high reliability of operations, EYDAP is upgrading its supervisory system and digital water strategy in the next 2 years and is keen to look and test alternatives to (a) facilitate the integration of different sensors from different vendors into a common system; (b) facilitate the development of different applications (models, analytics) by different developers on the data available; and (c) interface seamlessly with and provide added value to legacy systems (sensors and online control systems).

FIWARE will be used to integrate operational sensors (existing flow meters, stages and water quality sensors as discussed above, as well as 2 new open channel Doppler flowmeters) and other (novel) surveillance methods into a common operational picture (in real time). FIWARE compliant analytics and models will be developed to synthesise the information and provide operational decision support with an emphasis on (a) optimising water conveyance from sources to treatment plants in this extensive and complex multi-reservoir, multi-aqueduct (with pressurised sections) system and (b) providing early warning (with 1-2h lead time) in cases of increased turbidity, to allow the treatment plants to customise their processes accordingly. To support the first aspect, a water quantity routing application will be developed, whose functionalities in terms of use cases are described in Section V.1.i. Regarding the second aspect, a real time early warning water quality application will be developed, whose use cases in terms of use cases are described in Section V.1.ii.

The two applications will be demonstrated in a suitable part of the water supply system (Giona – Dafnoula aqueduct) and will initially act as an advice provision system –rather than actuation to build trust with operators.

Although in the Grant Agreement (WP4.1, task 4.1) it was initially stated that 'most probably the Amfissa - Dafnoula aqueduct for the water quantity applications and part of the Yliki aqueduct for the water quality applications' would be used for the Greek Demo Case, later on, during the works of WP1, it was decided that the Giona - Dafnoula part of the aqueduct is more suitable for both applications.

To begin with, Giona - Dafnoula is actually the same part of the aqueduct as the Amfissa - Dafnoula part. It is just more accurately described. Regarding the water quality application, it was decided that it would be better to use the Giona - Dafnoula part of the aqueduct as well. Thus, the demonstration of both Fiware4Water applications could be integrated and be more complete. Since the construction of the Mornos aqueduct, the Yliki aqueduct is used only in case of emergencies or during maintenance works of the main aqueduct, therefore monitoring its water quality is useful only in these rare occasions.

The existing on-line monitoring systems that are installed at the demo case part of the water supply system (Giona – Dafnoula aqueduct) are:

- 5 open channel flowmeters
- 46 water level meters
- 6 water quality meters (turbidity, conductivity, temperature)

More information about the installed monitoring systems is presented in Figures 1-3 and Tables 1-3.

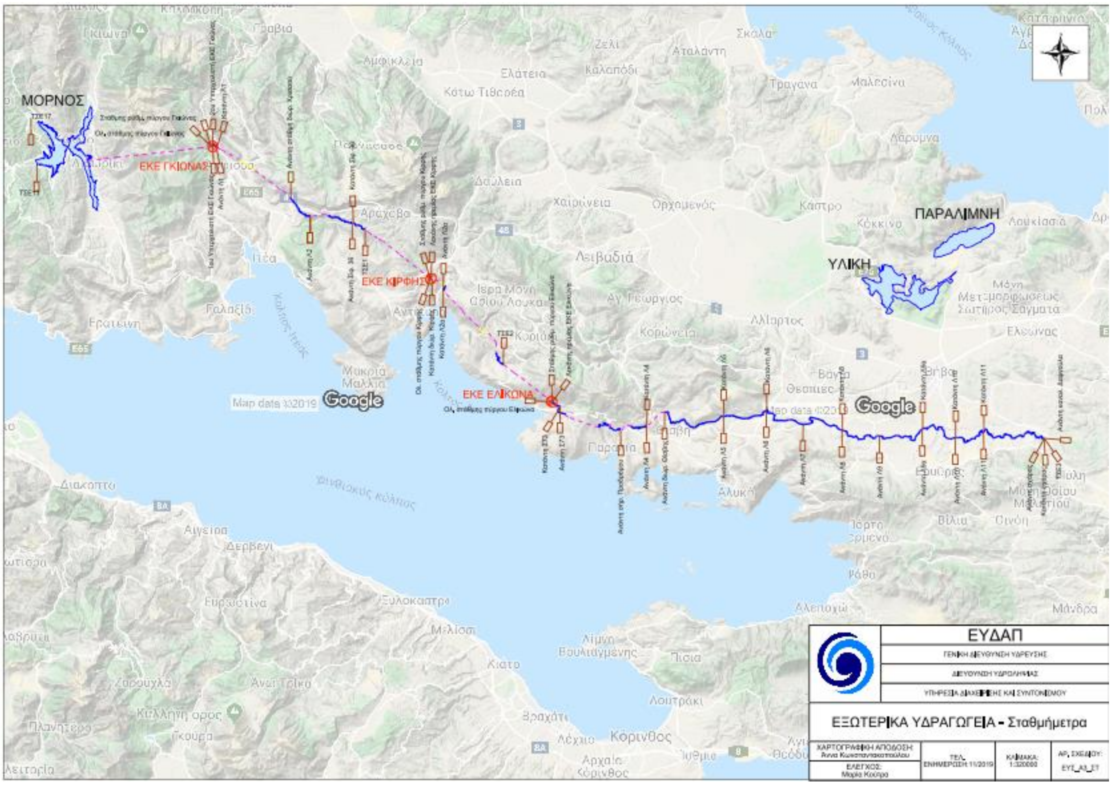

Figure 2: Part of the external raw water supply system of EYDAP (from Giona to Dafnoula) where the Fiware4Water solutions will be demonstrated. The markings along the supply system represent the installed water level meters.

Figure 3: Open channel flowmeters across the demo part of the external raw water supply system of EYDAP (from Giona to Dafnoula).

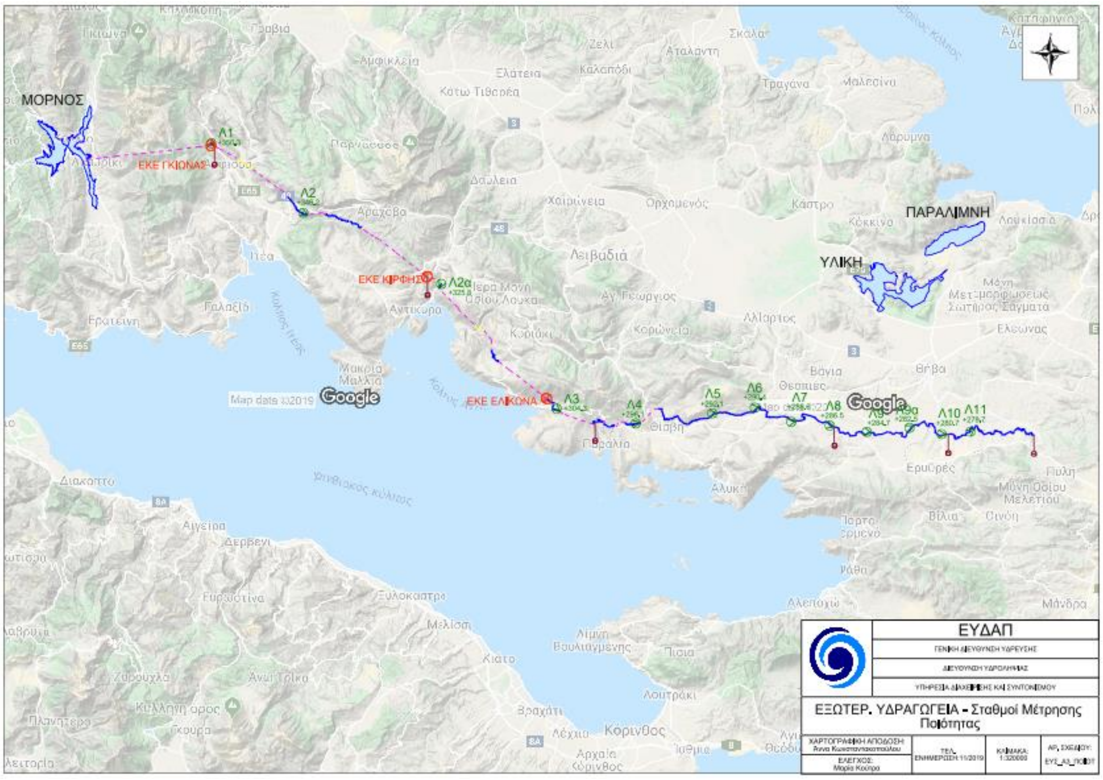

Figure 4: Water quality meters across the demo part of the external raw water supply system of EYDAP (from Giona to Dafnoula).

II.2. Demo Case #2. Cannes (France)

Table 2: Summary of Demo Case #2. Cannes

Case #2: FR	**Owner: SUEZ Smart Solutions (3S)**
Water Domain	Water supply network
Existing Situation	Advanced IT tools: AQUACALC™ and AQUADVANCED® Water Networks
Data Sources	Legacy sensors, AMRs, novel PROTEUS Sensor
Fiware4Water Apps	Preserve sensitive water resources; Meet water demands; Improve the performance of the drinking water distribution network; Monitor water quality
Objectives	Forecast water resources availability during summertime, forecast and manage water demands, decrease leakage, supply water compliant with quality standards

Cannes is located in the south east of France, on the shores of the Mediterranean Sea and close to the border with Italy. SICASIL (*Syndicat InterCommunal de l'Eau Potable du Bassin Cannois– in English: Inter-Communal Drinking Water Union of the Cannes Basin*) is in charge of managing the drinking water distribution service in eight municipalities, including Cannes. SICASIL has entrusted SUEZ Eau France with delivering the public drinking water service on its territory, within the framework of a contract (from 1993 to 2023). The Cannes basin has a population of 181,000 permanent inhabitants but reaches 500,000 during the peak season in summer– making water management in this water scarce environment very challenging. The total production capacity of the water resources is 88 hm^3. The total production capacity of the eight drinking water treatment plants reaches 31 hm^3, with an average quantity supplied currently 26 hm^3 per year. The distribution network is 987 km long and provides water to customers through 86,303 water meters.

Efficient and proactive water management is a key challenge for the Cannes basin, given that during summer, the water resources production capacity decreases and can reach 204,000 m3/day in a very dry year (e.g. 1990), instead of 242,000 m3/day. To be more proactive, SICASIL aims to improve its monitoring and medium-term forecast of water demand (over several days) to define effective water management strategies limiting the impact on scarce water resources and respecting operation constraints. Additionally, the reduction of leakage is a key imperative. In this vein, the numerous flow measurement points, including AMR devices with real-time monitoring capabilities, have been installed to identify undetectable leaks. SICASIL wants to integrate its distribution monitoring infrastructure and systems, and use them more efficiently to identify and fix leaks as early as possible while getting a better understanding of and handle on the evolution of demand. The quality of the water distributed is also an important challenge for SICASIL. In practice, however, the measurement of water quality in the distribution network is rare due to the high investment costs on the one hand and maintenance effort for the sensors on the other hand.

Four business issues have been identified for the French Demo Case:

- Preserve sensitive water resources by forecasting water resources availability during summertime
- Meet water demands of water consumption areas by forecasting water demands
- Improve the performance of the drinking water distribution network by detecting water leaks

- Monitor water quality by detecting abnormal water quality events

Different information sources (legacy systems) could be interfaced with FIWARE:

- **AQUACALC™:** a real time software, published by 3S; it is a data historian and a data manager
- **AQUADVANCED® Water Networks**: a real time software suite, published by 3S, dedicated to drinking water supply system:
    - **Production and Transport** (safety and security of drinking water supply)
    - **Distribution** (improvement of network performance and detection of water leaks)

An IT application, based on the product "Distribution" of AQUADVANCED® Water Networks, is already deployed on the site. The installation of an IT application based on the product "Production and Transport" is under discussion with SUEZ Eau France.

The Demo Case is also supplemented by water quality monitoring within the distribution network. The very innovative multiparameter probe (Fiware4Water sensor, evolved from PROTEUS) will be installed and full-scale tested on the SICASIL network. This probe was developed in the framework of the PROTEUS European project (H2020-ICT-2014). For this purpose, TZW will use a set of reference sensors as well as its own laboratory capacities to validate sensor readings in regular sampling campaigns. AQUADVANCED® Quality Monitoring is a service, based on AQUADVANCED® Water Networks, aiming at monitoring in real time the water quality of the drinking water supply system. One of its modules automatically detects abnormal water quality events but requires improvements. The measurements provided by the very innovative PROTEUS probe will be displayed and processed by AQUADVANCED® Quality Monitoring. 3S will develop IT connectors so that the aforementioned software can interface with FIWARE. Data from external legacy software, made available in the FIWARE platform, can be used by the Fiware4Water consortium to develop new components, modules or services with FIWARE accessible by SUEZ Eau France.

II.3. Demo Case #3. Amsterdam (the Netherlands)

Table 3: Summary of Demo Case #3. Amsterdam

Case #3: NL	**Owner: Waternet (WNT)**
Water Domain	Wastewater treatment plant
Existing Situation	SCADA; IoT system; Digitalisation strategy under fast implementation
Data Sources	Multiple water and gas quality sensors, flow sensors, pressure sensors and actuators
Fiware4Water Apps	Wastewater treatment optimisation
Objectives	Decrease greenhouse gasses, optimize energy use and treatment

WATNL's Wastewater Treatment Plant Amsterdam West (WWTP Amsterdam West) has a capacity of 1 Million population equivalent and serves the city of Amsterdam, itself a FIWARE supporter city as part of the Open and Agile Smart Cities Initiative. The process automation (PA) of WWTP Amsterdam West will be renewed and the IT architecture of WATNL is in fast development. This to enable WATNL to optimally benefit from implementation of upcoming technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Business Intelligence (BI) and streaming analytics to improve operational efficiency and asset management, and to reduce climate impact and costs.

Currently the control loops of WWTP Amsterdam West are for a large part dedicated to a single process. With the use of near real-time plant data, process models and external data sources a more optimal plant-wide control can be achieved. However, this is not possible with the current single process table or PID controllers. Therefore, WATNL will make one lane in WWTP Amsterdam West available for introducing and testing of additional sensors, data driven control strategies and decision support based on newly to be developed AI models and data fusion. The objective is to minimise N_2O emission, energy use and sludge production at minimum costs while meeting effluent water quality targets. Minimising N_2O emission has a large potential for further reduction of the CO_2 emission and thus for the ambition of WATNL to become climate neutral.

To this aim, an application will be developed that validates, fuses and analyses the data from current on-line water quality sensors (e.g. phosphate, nitrate, ammonium), off-gas sensors (e.g. oxygen, nitrous oxide) and flow sensors, combined with actuators in the treatment process (e.g. valves, recirculation pumps). The analyses consist of intelligent algorithms to detect sensor anomalies and to determine important process parameters e.g. soft sensors for oxygen uptake, respiration and nitrification rate. During the project, sensors will be selected and added to the treatment plant. Hence, the application needs to be able to adapt to an increasing number of sensors and additional data sources. Furthermore, the application will need to learn the relations between process conditions, nitrous oxide emissions and energy use to propose more optimal control settings for the treatment plant based on the predicted future states, sensor and soft sensor data. A dashboard to the end-users will be developed visualising performance indicators related to greenhouse gas emissions, energy use and effluent quality of WWTP Amsterdam West (near) real-time. The functionalities of the application to be developed are presented in Section V.3 in terms of use cases.

II.4. Demo Case #4. Great Torrington (UK)

Table 4: Summary of Demo Case #4. Great Torrington

Case #4: UK	**Owner: South West Water (SWW)**
Water Domain	Smart metering: Customers and Water Utility
Existing Situation	Large smart meter network, existing community hub
Data Sources	Smart meters deployed
Fiware4Water Apps	Near real time monitoring of household consumption; advice to customers
Objectives	Understand demand; enhance citizen acceptability & engagement; improve network management

South West Water (SWW) provides drinking water and wastewater services for approximately 1.7 million customers in the South West of England, and drinking water services to approximately 0.5 million customers in Bournemouth, South England.

Currently around 70% of these customers are metered using standard meters manually read twice a year and a further 15% are metered using AMR (Automatic Meter Reading). AMR meters provide the opportunity for more frequent meter reads however SWW have yet to take full advantage of this for a mix of logistical and technical reasons. Smart meters represent a significant opportunity for SWW to obtain up to date data on customer consumption to help manage the water system more efficiently. Benefits include faster response to events (customer leaks and larger bursts), predicting short term water demand, and a refined understanding of leakage at household and area level for reporting. Smart metering is also an opportunity to effectively engage with customers and influence their behaviour with respect to water usage. SWW's experience has shown that metered customers use significantly less water than customers who are not metered. We expect that increased visibility of water use behaviour will drive an even larger reduction in a customer's water consumption. The benefits of which will be realised by SWW with a lower overall demand on resources and treatment requirements, and by the customer with a lower annual water bill.

Smart metering in the water industry is far behind other industries like gas and energy principally due to installation restrictions and market demand. A smart water meter typically needs to be installed in an underground chamber where there is no electricity connection. The capital costs covering installation and maintenance (e.g. to replace a battery) are much higher and often out-weigh the benefits. There is also less customer demand for a smart water meter since it is generally considered a cheaper resource than gas or electricity.

SWW are looking to FIWARE to provide a cost effective, scalable solution which will help overcome these challenges and deliver the benefits needed to justify further capital investment in smart metering. An area in mid-Devon, Great Torrington has been chosen to pilot the technology. Customers in this region will have smart meters installed and be given access to a smart phone application displaying their water consumption. Customers will be able to see how much they are paying for water, compare their consumption against others, set consumption targets and receive leak alarm notifications. SWW will use the data from these smart meters to locate household leaks in the area and derive relationships between consumption and the weather (e.g. rainfall) via an internally accessed web application. The functionalities of the applications that are to be developed for the consumer and water utility domain are presented in terms of use cases in Sections V.4.i and V.4.ii, respectively.

III. Methodology for *Use Case* identification

III.1. The concept of *Use Case*

According to OMG [1], "*Use Cases is a means to capture the requirements of the systems, i.e., what systems are supposed to do*". The concept of "use cases" is part of the Unified Modelling Language (UML) that is a general-purpose standardised language based on diagrams to support the design of software systems. Use cases are part of the behaviour diagrams of UML and are based on three key elements:

- Subject: a system under consideration to which use cases are applied
- Actor: a user and any other system that may interact with a subject (system)
- Use case: a set of behaviours (interactions) performed by actor and a subject (system) to achieve a goal, which yields an observable result that is of value for Actors or other stakeholders of the subject

Use cases formalism enables the description of the high-level interactions between the actor and the subject (system) in an intentionally simple way in order to establish full communication between the developers of the system and the stakeholders involved. In this vein, further using graphical representation of these interactions (diagrams), the use cases are described in a textual form, usually on the basis of predefined templates. The latter approach is followed here to describe the use cases of the FIWARE-compliant Smart Water Applications that are to be developed in the framework of F4W project.

III.2. *Use cases* identification procedure

The identification and articulation of the use cases, and then of the system requirements, for the FIWARE-compliant Smart Water Applications was conducted at all four demo cases according to the step-by-step procedure presented in Figure 5. The procedure is evolved through three workshops between the local utility and the local research pattern at each demo case to ensure a consensus on the final set of use cases and system requirements.

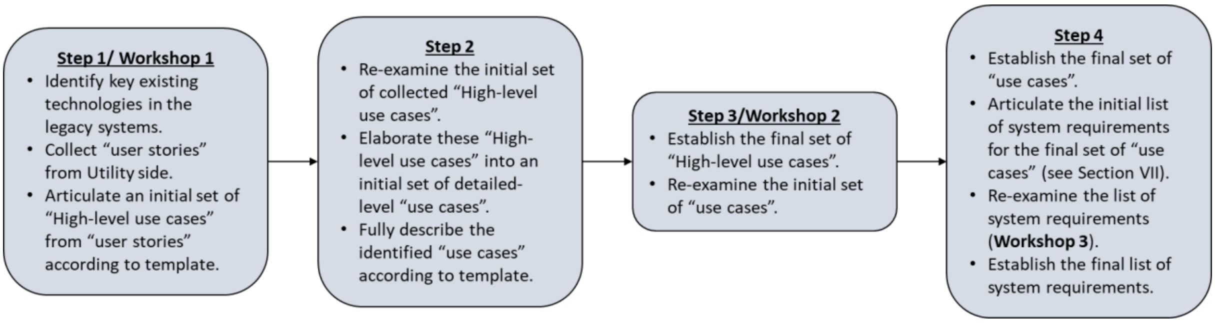

Figure 5: Step-by-step procedure for "use cases" identification and articulation

Prior to 1st workshop (in Step 1), as a preparatory step a guide for the identification and description of use cases was compiled and distributed among the partners of F4W aiming to facilitate the workshops at each demo case, ensuring a common procedure across the four demo cases. This guide is given in Annex 1.

Step 1 coincides with the 1st workshop at each demo case and has as ultimate target the collection of the user stories from water utilities. The user stories describe the key functionalities and the major processes of the FIWARE-compliant Smart Water Applications and are selected with criterion the challenges that utilities want to address as well as the current state of play of the legacy systems (existing datasets, existing sensors and actuators that enable dataflow, existing SCADA systems and protocols). To establish of a common procedure across all four demo cases, the user stories are identified and described on the basis of "High-level use cases" using a common template (see Section III.3). Using this template, an initial set of "High-level use cases" was compiled during the 1st workshop at each demo case.

In Step 2, the initial set of "High-level use cases" for each demo case is revised by the corresponding local research partner and an initial list of "Detailed-level use cases" (termed hereinafter as "use cases") is compiled for each High-level use case. In other words, the major processes of the FIWARE-compliant Smart Water Applications are further broken down into more specific functionalities. The use cases are described using a common template for all four demo cases, as presented in Table 5.

In Step 3, the final set of "High-level use cases" is established and the initial set of use cases are revisited by the water utility during the 2nd workshop.

In Step 4, the local research partner establishes the final set of use cases and composes an initial list of "system requirements" (see Section VI) for each use case. The initial set of "system requirements" is revised by the water utility and the local research partner during the 3rd workshop.

III.3. *Use cases* description template

The identification and description of use cases for the FIWARE-compliant Smart Water Applications is conducted in a textual form via a specific template, applied to all four demo cases in the framework of the above described procedure. In this vein, we take advantage of experience from relevant past developments and we built upon a successfully applied template used in the framework of the EU-funded iWIDGET project [2] for the design of relevant applications concerning the efficient water use and related energy consumption by water utilities and consumers through the use of smart metering technologies [3,4]. Specifically, we employ the template given in Table 5 presenting the key elements (left column) that fully describe a uses case and their definition (right column).

Table 5: Use case collection template

Unique ID and use case name	Use case reference number and name the use case from the perspective of the actors' goals
Domain	Each use case belongs to a domain, which corresponds to a business environment
Goals	Stakeholder's goals addressed by the use case
Actors	Actor that initiates this use case and all other actors who participate in this use case
Description	Verbal description of the use case regarding the goals to be achieved
Pre-condition	Conditions that must be met for use case to start
Post-condition	Conditions that must be met for use case to terminate successfully
Data source	Description of the source of the data required for this use case
Trigger	The event or sequence of events that initiate the use case
Constraints	Aspects that might condition the use case
Main flow	List of interactions between the actors and the system
Alternative flow	Any variations in the main flow of a use case (on the manner or mode in which it may happen)
Issues	List of issues that remain to be resolved
Relationship with other use cases	List of use cases that are related

For the standardisation of user stories and their description as "High-level use cases", as described in the procedure presented in Section III.2, the following elements of the above template are used:

- Unique ID and name
- Domain
- Goals
- Actors involved
- Verbal description of the use case
- Constraints
- Relationship with other use case

The Unique ID for each use case is formulated as: <DM>.<WU>.<SAn>.<USn>.<UCn>

where:

- <DM> corresponding to the country of a specific Demo Case
- <WU> corresponding to the owner (water utility) of the Demo Case
- <SAn> sequential numbering of the Smart Application of the Demo Case
- <USn> sequential numbering of the high-level use case (user story)
- <UCn> sequential numbering of the use case included in the high-level use case

For example, a high-level use case for the Smart Application 1 (i.e., water quantity routing application) of Athens Demo Case is coded as:

- GR.EYDAP.SA1.US01

While, the first lower-level use case of this high-level use case is coded as:

- GR.EYDAP.SA1.US01.UC01

In the use cases described in the next sections, two different types of end-users are discerned (the element "Domain" in the above use case template). In the case of the Athens, Cannes and Netherlands demo case, the end-user of FIWARE-compliant Smart Water Applications is the water utility. In the case of UK demo case, use cases for both water utility and consumers are described with respect to the relevant applications.

IV. High-level use cases (User stories)

This section presents the High-level use cases (User stories) for the Athens (Section IV.1), Cannes (Section IV.2), Amsterdam (Section IV.3) and Great Torrington (Section IV.4) demo case.

IV.1. High-level use cases for Demo Case #1. Athens (Greece)

In Athens demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.1). The High-level use cases of "water quantity routing application" are presented in Section IV.1.i, while those of "water quality early-warning application" in Section IV.1.ii.

IV.1.i. Water quantity routing application

The list of user stories with the corresponding use cases for the "water quantity routing application" is:

- **User Story GR.EYDAP.SA1.US01: Monitor flow conditions**
  - Use Case GR.EYDAP.SA1.US01.UC01: Obtain real-time information on water flow
  - Use Case GR.EYDAP.SA1.US01.UC02: Get access and analyse historical flow data
- **User Story GR.EYDAP.SA1.US02: Understand flow conditions**
  - Use Case GR.EYDAP.SA1.US02.UC01: Obtain information on the status of sensors and accuracy of real-time measurements
  - Use Case GR.EYDAP.SA1.US02.UC02: Receive warnings about unusual flow conditions
  - Use Case GR.EYDAP.SA1.US02.UC03: Obtain information on water losses

  - Use Case GR.EYDAP.SA1.US02.UC04: Obtain estimations of future water demand volumes

- **User Story GR.EYDAP.SA1.US03: Act to change flow conditions**
  - Use Case GR.EYDAP.SA1.US03.UC01: Get support on sluice gates operational settings
  - Use Case GR.EYDAP.SA1.US03.UC02: Get support on the scheduling of sluice gate operation

Table 6: GR.EYDAP.SA1.US01: Monitor flow conditions

Unique ID and user story name	GR.EYDAP.SA1.US01: Monitor flow conditions
Domain	Water utility
Goals	Monitor the flow in the water conveyance system on a real-time basis and get access to historical data and meaningful information.
Stakeholders	System operation staff
Description	This user story concerns the monitoring of the flow of the conveyance system. Water utility gets access to real-time data as well as past flow measurements in different locations of the water conveyance system through a web platform. The platform supports different types of information (e.g., water flow, water depth, flow velocity, volumes of water) allowing the user to specify the temporal and spatial scale of analysis. This allows operating staff to monitor the temporal and spatial changes in the flow, receiving valuable information and comparative statistics.
Constraints	• Unavailability of real-time data • Unavailability of historical data • Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the topology of the system. • Unavailability of information on the location of sensors. • Short sample (record with length smaller than 1 year) of historical flow data not allowing to capture the seasonal variability of flow conditions in the channel.
Data source	• Real-time data from sensors (both new sensors and those of the legacy SCADA system). • Historical data from water utility’s database (from both new sensors and those of the legacy SCADA system) • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility.

Table 7: GR.EYDAP.SA1.US02: Understand flow conditions

Unique ID and user story name	GR.EYDAP.SA1.US02: Understand flow conditions
Domain	Water utility
Goals	Improve the understanding of flow conditions in the conveyance system.
Stakeholders	System operation staff
Description	This user story concerns in a series of functionalities that aim to improve the understanding and management of the flows in the conveyance system. These include: (a) the monitoring of sensors and the altering in case of faulty measurements; (b) warnings in the case of suspected flow conditions (measurements out of usual bounds and high rate of changes over time or scale); (c) information on the mass balance with focus on water losses and; (d) estimations of future water demand volumes based on past data.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Short sample (record with length smaller than 1 year) of historical flow data not allowing to capture the seasonal variability of flow conditions in the channel. • Unavailability of information on technical specifications of the sensors. • Unavailability of numerical estimations from the simulation scheme. • Availability of information in the operating conditions of the system.
Data source	• Real-time data from sensors (both new sensors and those of the legacy SCADA system). • Historical data from water utility's database (from both new sensors and those of the legacy SCADA system). • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility. • Information on technical specifications of sensors, provided by water utility. • Estimations of flow from simulation. • Information on the different operating conditions of the system, provided by water utility. • Historical water demand data, provided by water utility.

Table 8: GR.EYDAP.SA1.US03: Act to change flow conditions

Unique ID and user story name	GR.EYDAP.SA1.US03: Act to change flow conditions
Domain	Water utility
Goals	Support water utility towards the optimal scheduling and control of the sluice gates of the conveyance system.
Stakeholders	System operation staff
Description	Water utility gets support on the optimal setting and scheduling of the sluice gates to establish specific flow conditions in the water conveyance system. The platform supports the configuration of alternative simulation scenarios.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of data at a specific point of the conveyance system. • Unavailability of stage data at the point of interest
Data source	• Flow data from the sensors at the point downstream. • Topology of the system (length of channels, characteristics and geometry of cross-sections), provided by water utility. • Information on the initial status of sluice gate opening (initial conditions), provided by water utility. • Data on stage at the points upstream and downstream, provided by water utility

IV.1.ii. Water quality early-warning application

The list of user stories with the corresponding use cases for the “water quality early-warning application” is:

User Story GR.EYDAP.SA2.US01: Monitor water quality

- Use Case GR.EYDAP.SA2.US01.UC01: Obtain real-time information on water quality
- Use Case GR.EYDAP.SA2.US01.UC02: Get access and analyse historical water quality data

User Story GR.EYDAP.SA2.US02: Understand water quality

- Use Case GR.EYDAP.SA2.US02.UC01: Obtain information on the operating status of sensors
- Use Case GR.EYDAP.SA2.US02.UC02: Receive information and warnings about unusual quality events
- Use Case GR.EYDAP.SA2.US02.UC03: Obtain information on the time needed for a quality event to travel downstream

Table 9: GR.EYDAP.SA2.US01: Monitor water quality

Unique ID and user story name	GR.EYDAP.SA2.US01: Monitor water quality
Domain	Water utility
Goals	Monitor the quality of water of the aqueduct on a real-time basis and get access to past measurements and meaningful information.
Stakeholders	Water quality control staff, WTP operators
Description	This user story concerns the monitoring of the water quality of the conveyance system. Water utility gets access to real-time data as well as past water quality measurements in different locations of the water conveyance system through a web platform. The platform supports different levels of detail and forms of information (e.g., overall view, at specific locations) allowing the user to specify the temporal and spatial scale of analysis. This allows operating staff to monitor the temporal and spatial changes in the water quality of the conveyance system, receiving valuable information and comparative statistics.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the location of sensors. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of water quality parameters.
Data source	• Real-time data from quality sensors. • Historical quality data from water utility's database • Location of the sensors, provided by water utility.

Table 10: GR.EYDAP.SA2.US02: Understand water quality

Unique ID and user story name	GR.EYDAP.SA2.US02: Understand water quality
Domain	Water utility
Goals	Improve the understanding of quality the raw water in the conveyance system.
Stakeholders	Water quality control staff, WTP operators
Description	Water utility receives various real-time information, warnings and alters concerning the quality of the raw water in the conveyance system aiming to facilitate and improve the operation of the WTP. These concern unusual changes in the quality of water over time and

	scale (different locations in the system) and measurements that indicate unusual quality events. Furthermore, water utility obtains information on the status of the metering devices improving in this way their management and operation. These are delivered via an advanced visual environment that incorporates many graphical capabilities and features. This user story concerns in a series of functionalities that aim to improve the understanding and management of the water quality of the raw water in the conveyance system. These include: (a) the supervision of sensors and altering in the case of faulty measurements or malfunctions of metering devices; (b) warnings about unusual quality events and; (c) estimations on the time needed for a quality event to travel downstream.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of water quality parameters. • Unavailability of information on technical specifications of the sensors
Data source	• Real-time data from quality sensors. • Location of the sensors, provided by water utility. • Topology of the conveyance system, provided by water utility. • Rea-time data from flow sensors. • Thresholds for quality parameters, provided by water utility. • Information on quality parameters under different operating conditions of the system, provided by water utility.

IV.2. High-level use cases for Demo Case #2. Cannes (France)

In Cannes demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.2) The High-level use cases of "Production and transport" are presented in Section IV.2.i, while those of "Distribution" in Section IV.2.ii.

IV.2.i. Production and transport

The list of user stories with the corresponding use cases for the "Production and transport" is:

User Story FR.3S.SA1.US01: Preserve sensitive water resources

- Use Case FR.3S.SA1.US01.UC01: Forecast water resources availability during summertime

- Use Case FR.3S.SA1.US01.UC02: Display water resources availability forecasts

User Story FR.3S.SA1.US02: Meet water demands

- Use Case FR.3S.SA1.US02.UC01: Forecast water demand

Table 11: FR.3S.SA1.US01: Preserve sensitive water resources

Unique ID and user story name	FR.3S.SA1.US01: Preserve sensitive water resources
Domain	Water utility
Goals	Preserve sensitive water resources during summertime to manage rationally drought episodes.
Stakeholders	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	The Côte d'Azur Agency of SUEZ Eau France is in charge of operating the SICASIL drinking water supply system (production, transport and distribution). Different water resources (lake, channels, springs) are used to produce drinking water. The Cannes basin is in the south of France, it is a very sunny area. Moreover, its population is 181,000 permanent inhabitants but it reaches 500,000 during the peak season, making water management in this water scarce environment very challenging. Operators have already experienced very intense droughts, for example during the summer of 2017 when no withdrawals were allowed from certain water resources. Each year, at the end of spring, operators want to know if some of their water resources will be water stressed during the summer, given the rainfalls during the past winter and spring. The knowledge of the availability of each water resource for the coming summer would avoid the overuse of sensitive resources and help to manage them parsimoniously and rationally throughout the summertime: mainly over the period from 15 June to 15 September. Currently, operators do not use any tool to estimate summer water stress. Their assessment is based primarily on their experience and their knowledge on similar past weather situations. The functions associated with the user requirements described in the following use cases must be available in the AQUADVANCED® Water Networks software – legacy system (publisher: 3S).
Constraints	N/A
Data source	• Weather data and water resources availability data should be stored in the AQUADVANCED® Water Networks database.

	• Data for the machine learning phase (used to build the model in differed time from historical data sets): – Rainfalls and temperatures of past winters, springs and summers – Water resources availability of past winters springs and summers (for each water resource) • Data for the computation phase (used to run the model in real time): – Rainfalls and temperatures of the past winter and spring – Long-term rainfalls and temperatures forecasts for the coming summer

Table 12: FR.3S.SA1.US02: Meet water demands

Unique ID and user story name	FR.3S.SA1.US02: Meet water demands
Domain	Water utility
Goals	Forecast the water demand for each water consumption area.
Stakeholders	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	The user story FR.3S.SA1.US01 "Preserve sensitive water resources" underlined the operating constraints of the water supply system of SICASIL: a very sunny region with a high number of tourists in the summer. In this context, satisfying water demands, 7 days a week and 24 hours a day, requires forecasting water demand for each water consumption area with accuracy. Water demand takes into account all water that is consumed and demanded, by domestic and non-domestic consumers. Currently, operators do not use any tools to estimate the water demands. Their assessment is based primarily on their experience and their knowledge on similar past water consumption events. Based on the slow or rapid evolution of the level of the reservoirs observed on the SCADA, the operator mentally estimates every day the future water demand for each consumption area and adapts the production and distribution of drinking water accordingly. The functions associated with the user requirements described in the following use cases must be available in the AQUADVANCED® Water Networks software – legacy system (publisher: 3S).
Constraints	• Limited data about future demand of big consumers (e.g. harbour).
Data source	• Meteorological parameters:

	– Current and past temperatures over the last two weeks – Temperature forecasts over two weeks – etc. • Public holiday agenda • Data about tourist numbers • Current and past water consumptions over one or two weeks of each water consumption area stored in the AQUADVANCED® Water Networks database

IV.2.ii. Distribution

The list of user stories with the corresponding use cases for the “Distribution” is:

User Story FR.3S.SA2.US01: Improve the performance of the drinking water distribution network

- Use Case FR.3S.SA2.US01.UC01: Collect data
- Use Case FR.3S.SA2.US01.UC02: Detect water leaks
- Use Case FR.3S.SA2.US01.UC03: Improve decision making
- Use Case FR.3S.SA2.US01.UC04: Detect fast hydraulic transients

User Story FR.3S.SA2.US02: Monitor water quality

- Use Case FR.3S.SA2.US02.UC01: Collect data
- Use Case FR.3S.SA2.US02.UC02: Detect abnormal water quality events

Table 13: FR.3S.SA2.US01: Improve the performance of the drinking water distribution network

Unique ID and user story name	FR.3S.SA2.US01: Improve the performance of the drinking water distribution network
Domain	Water utility
Goals	Preserve water resources by improving the performance of the drinking water network, by quickly and reliably detecting water leaks.
Stakeholders	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	Various issues motivate the "Côte d'Azur" Agency to improve the efficiency of its network: the preservation of water resources, ageing pipes and increasing financial constraints. The improvement of network performance relies heavily on the ability to detect leaks reliably and quickly, but other components can contribute to

	accelerate the process of handling a leak (diagnosis, decision and intervention), for example: – Consider different sources of information (e.g. acoustic sensors, sectorization flow meters, automated meter reading, high-frequency pressure sensors to detect fast and recurrent hydraulic transients that can cause damage to the network, etc.). – Group together in a single graphical view the necessary and enough information to speed up and make reliable the leak diagnosis by the operator – Record comments on a handrail to trace events and work occurring in a hydraulic sector (e.g. maintenance work, flow meter change, etc.). – Communicate internally at the network operators and externally with the municipality. – etc. The functions associated with the user requirements described in the following use cases must be available in the AQUADVANCED® Water Networks software – legacy system (publisher: 3S).
Constraints	N/A
Data source	• Different types of data sources need to be considered: – Sectorisation flowmeters: night flow monitoring – Automated Meter Reading (AMR): water consumption monitoring – Leak noise loggers: acoustic monitoring – High-frequency pressure sensors: water hammers detection – etc.

Table 14: FR.3S.SA2.US02: Monitor water quality

Unique ID and user story name	FR.3S.SA2.US02: Monitor water quality
Domain	Water utility
Goals	Monitor and detect abnormal water quality events in the distribution network from water quality sensors or multi-parameter probes.
Stakeholders	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	In a more stringent context on the safety and security of drinking water supplies, operators wish to monitor variations in the quality of drinking

	water and increase their reactivity in the event of anomalies or potential pollution. The SICASIL distribution network does not currently contain any quality sensors, except for the chlorine sensors located at the output of the reservoirs. Some quality sensors and multi-parameter probes will be installed on this network, for example the Fiware4Water probe, based on carbon nanotubes, designed by the CNRS. The general objective is to detect and locate drinking water quality anomalies in real time using probes placed at strategic control points in the distribution network, in order to act as soon as possible when a risk is confirmed. The functions associated with the user requirements described in the following use cases must be available in the AQUADVANCED® Water Networks software – legacy system (publisher: 3S).
Constraints	N/A
Data source	• It depends on the future probes and sensors deployed on the distribution network: – One or several prototypes of Fiware4Water multi-parameter probe based on PROTEUS (designed by CNRS and packaged by EGM). Probably not available before the third year of the project – 1 spectrolyser probe (manufacturer: scan) provided by TZW (to be confirmed). – 1 panel with traditional sensors (pH, electrical conductivity, turbidity, redox) provided by TZW (to be confirmed). – 4 nanostations (manufacturer: scan) provided by SUEZ / CIRSEE. These are multi-parameter probes measuring 7 parameters: pH, temperature, conductivity, free chlorine, UV254, TOC and turbidity – 5 or 6 multi-parameter probes: pipescans or nanostations (manufacturer: scan). SICASIL could launch a restricted consultation to implement quality probes (5 or 6) on their network but this scenario is not certain. 3S is waiting for a feedback from the Côte d'Azur Agency of SUEZ Eau France, in charge of operating the SICASIL network.

IV.3. High-level use cases for Demo Case #3. Amsterdam (the Netherlands)

In Amsterdam demo case, a FIWARE-compliant Smart Water Application is going to be developed (see Section II.3). The list of user stories with the corresponding use cases for the "WWTP optimisation application" is:

- **NL.WNT.SA1.US01: Optimisation of WWTP research lane**
    - Use case NL.WNT.SA1.US01.UC01: Obtain near real-time validated sensor data of the WWTP research lane
    - NL.WNT.SA1.US01.UC02: understand the performance of the WWTP research lane
    - Use case NL.WNT.SA1.US01.UC03: short-term forecast the process behaviour and performance of the WWTP research lane
    - NL.WNT.SA1.US01.UC04: control of the processes and performance of the WWTP research lane

Table 15: NL.WNT.SA1.US01: Optimisation of WWTP research lane

Unique ID and user story name	NL.WNT.SA1.US01: Optimisation of WWTP research lane
Domain	Water utility
Goals	Optimise the wastewater treatment process of the research lane with respect to greenhouse gas emissions (such as N_2O), energy costs and effluent quality
Stakeholders	Process technologist (PT) and process operators (PO), management, water authority AGV
Description	WNT's Wastewater Treatment Plant (WWTP) Amsterdam West has a capacity of 1 Million population equivalent and serves the city of Amsterdam. Currently the control loops of WWTP Amsterdam West are for a large part dedicated to a single process. With the use of near real-time plant data, process models and external data sources a more optimal plant-wide control can be achieved. However, this is not possible with the current single process table or PID controllers. Therefore, WNT will make one lane in WWTP Amsterdam West available for introducing and testing of additional sensors, data driven control strategies and decision support based on newly to be developed AI models and data fusion. The objective is to optimise greenhouse emissions, energy costs and water quality. Minimising N_2O emission has a large potential for further reduction of the CO_2 emission and thus for the ambition of WNT to become climate neutral.
Data source	• Water utility's database or a previously installed system (legacy system) to provide time series / historical data of measured data. • Water utility's information about sensor and actuator specifications. • Water utility's information on the layout of the treatment plant and treatment lanes. • External data sources, e.g. historical and forecasted weather data.

Constraints	• Availability, reliability and accuracy of sensors, actuators and external data (sources), and the quality of (internal and external) data presented by the system. • Implementation of an optimal, model-based controller, • The performance of the controller within the system.

IV.4. High-level use cases for Demo Case #4. Great Torrington (UK)

In Great Torrington demo case, FIWARE-compliant applications for smart metering systems are going to be developed, targeting both the utility and consumer domain (see Section II.4). The High-level use cases for the utility domain are presented in Section IV.4.i, while those for the consumer domain in Section IV.4.ii.

IV.4.i. Water utility domain

The list of user stories with the corresponding use cases for the water utility domain is:

- **User Story UK.SWW.SA1.US01 Access to Consumption Data**
    - Use Case UK.SWW.SA1.US01.UC01: Obtain water consumption data from smart metered households
- **User Story UK.SWW.SA1.US02 Analysis of Consumption Data**
    - Use Case UK.SWW.SA1.US02.UC01: Leak alarms from smart meters
    - Use Case UK.SWW.SA1.US02.UC02: Suspected leak alerts from analysis of smart data
    - Use Case UK.SWW.SA1.US02.UC03: Triaging consumption data with other time series data (e.g. rainfall data)

Table 16: UK.SWW.SA1.US01: Access to Consumption Data

Unique ID and user story name	UK.SWW.SA1.US01: Access to Consumption Data
Domain	Water utility
Goals	Access to water consumption data
Stakeholders	Water Utility
Description	The system monitors water consumption at the household level.
Data source	• Smart meters at household level to provide daily consumption data (sigfox & temetra) • Network devices, i.e. night use loggers • Legacy corporate systems holding consumption data (typically 6 monthly manual reads or via customer meter read) • External time series data

Constraints	• Availability of accurate consumption data • Robustness of communication infrastructure (e.g. masts) • FIWARE connection to sigfox, temetra and integration with legacy water company systems

Table 17: UK.SWW.SA1.US02: Analysis to Consumption Data

Unique ID and user story name	UK.SWW.SA1.US02: Analysis to Consumption Data
Domain	Water utility
Goals	Analysis of water consumption data to identify suspected leaks and explore relationships between time series data and consumption data
Stakeholders	Water Utility
Description	A platform to receive leak alarm data from the smart meters that will interact, manipulate and analyse consumption data to inform suspected leak alerts. The system will also monitor water consumption at the household level and overlays spatially relevant time series data from other sources
Data source	• Smart meters at household level to provide leak alarm data (sigfox & temetra) • Smart meters at household level to provide daily consumption data (sigfox & temetra) • Network devices, i.e., night use loggers • Legacy corporate systems holding consumption data (typically 6 monthly manual reads or via customer meter read) • External time series data
Constraints	• Availability of leak alarm data from smart meter • Availability of accurate consumption data from smart meter • Algorithm to identify suspect leaks (as opposed to genuinely high consumption) • Availability and granularity of other time series data • Robustness of communication infrastructure (e.g. masts) • FIWARE connection to Sigfox, temetra and integration with legacy water company systems

IV.4.ii. Consumer domain

The list of user stories with the corresponding use cases for the consumer domain is:

- **User Story UK.SWW.SA2.US01 Customer Access to Consumption Data**
  - Use Case UK.SWW.SA2.US01.UC01: Application for customers to view their consumption data
- **User Story UK.SWW.SA2.US02 Positive impact on customers water use behaviour**
  - Use Case UK.SWW.SA2.US02.UC01: access to consumption data makes positive impact on customers water use behaviour

Table 18: UK.SWW.SA2.US01: Customer Access to Consumption Data

Unique ID and user story name	UK.SWW.SA2.US01: Customer Access to Consumption Data
Domain	Consumer
Goals	Access to water consumption data for customers
Stakeholders	Domestic Customer, Water Utility
Description	The system monitors water consumption at the household level and provides easy and secure data access
Data source	• Smart meters at household level to provide daily consumption data (sigfox & temetra) • Legacy corporate systems holding consumption data (typically 6 monthly manual reads or via customer meter read)
Constraints	• Availability of accurate consumption data • Robustness of communication infrastructure (e.g. masts) • FIWARE connection to Sigfox, temetra and integration with legacy water company systems

Table 19: UK.SWW.SA2.US02: Influencing customers water use behaviour

Unique ID and user story name	UK.SWW.SA2.US02: Influencing customers water use behaviour
Domain	Consumer
Goals	Engagement with the customer to help them manage their water consumption
Stakeholders	Domestic Customer, Water Utility
Description	A platform for our customers to interact with their daily water consumption data. To include comparative analysis (neighbours, social

	groups, etc.), budget setting and leak alerts to help reduce consumption and bills
Data source	• Smart meters at household level to provide daily consumption data (sigfox & temetra) • Customer profiles submitted via the portal by the customer
Constraints	• Availability of accurate consumption data • Algorithms to provide comparative information

V. Use cases

This section presents the use cases for the Athens (Section V.1), Cannes (Section V.2), Amsterdam (Section V.3) and Great Torrington (Section V.4) demo case.

V.1. Use cases for Demo Case #1. Athens (Greece)

In Athens demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.1). The use cases of "water quantity routing application" are presented in Section V.1.i, while those of "water quality early-warning application" in Section V.1.ii.

V.1.i. Water quantity routing application

Table 20: GR.EYDAP.SA1.US01.UC01: Obtain real-time information on water flow

Unique ID and use case name	GR.EYDAP.SA1.US01.UC01: Obtain real-time information on water flow
Domain	Water utility
Goals	Monitor the flow in the water conveyance system on a real-time basis
Actors	System operation staff
Description	Water utility gets access to flow data on a real-time basis from the installed sensors in the water conveyance system, via the web platform. The homepage of the platform provides real-time overview information on the current flow regime of the conveyance system (e.g., mean flows, rate of changes of flow between different locations, water volumes in the system). Furthermore, the platform enables the user to monitor the entire under-study part of system through a graphical interface (digital representation of the system), where by pointing a sensor the user gets access to the real-time flows at the corresponding location. The user can specify the type of the presented information, e.g., water flow, water depth, flow velocity, volumes of water. The system supports

	different ways of visualisation such as time series charts, tables and reports.
Pre-conditions	• Availability of real-time data from sensors. • Availability of the location of sensors. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections).
Post-conditions	System operation staff gets the requested real-time data
Data source	• Real-time data from sensors (both new sensors and those of the legacy SCADA system). • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility.
Trigger	System operation staff requests access to real-time data
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the topology of the system. • Unavailability of information on the location of sensors.
Main flow	• User logs on to the platform via an authentication procedure • Platform displays the facilities available to the user • User selects the options related to the real-time monitoring of the conveyance system. • User selects data processing and visualisation options (e.g., location of sensor, temporal scale, units of presented information) • System processes data according to the selected options and displays the real-time information • User accesses to data, can print a report, save the data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 21: GR.EYDAP.SA1.US01.UC02: Get access and analyse historical flow data

Unique ID and use case name	GR.EYDAP.SA1.US01.UC02: Get access and analyse historical flow data
Domain	Water utility

Goals	Get access and analyse historical flow measurements from sensors of the conveyance system.
Actors	System operation staff
Description	Water utility gets access to historical flow data from the sensors in the water conveyance system, via the web platform. The user, via the graphical interface, can request access to the historical data of a single sensor (location) for further processing and analysis. The system provides the flexibility to the user to determine the type of the presented information (e.g., water flow, water depth, flow velocity, volumes of water), the temporal resolution (e.g., instant, hourly, daily etc.) and the time period of interest. The system displays meaningful information and statistics (e.g., trends, peaks) for the under study measurements aiming to improve user's understanding on the variation of flow over time. Furthermore, the user is able to request comparative information regarding the historical data of different time periods as well as between different locations (i.e., variation over space). The system supports different ways of visualisation for the presented information such as time series charts, tables and reports.
Pre-conditions	• Availability of historical data. • Availability of the location of sensors. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections).
Post-conditions	System operation staff gets the requested information
Data source	• Historical data from water utility's database (from both new sensors and those of the legacy SCADA system) • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility.
Trigger	System operation staff requests access to data
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the topology of the system. • Unavailability of information on the location of sensors. • Short sample of historical data (i.e., record with length smaller than 1 year) not allowing to capture the seasonal variation of flow conditions.
Main flow	• User logs on to the system via an authentication procedure

	• User selects the options related to the historical flow measurements • User defines the parameters of the temporal and spatial analysis, the time period of measurements and the type (units) of presented information. • System processes data according to the selected options and displays the results • User accesses to data and can print a report, save the data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 22: GR.EYDAP.SA1.US02.UC01: Obtain information on the status of sensors and accuracy of real-time measurements

Unique ID and use case name	GR.EYDAP.SA1.US02.UC01: Obtain information on the status of sensors and accuracy of real-time measurements
Domain	Water utility
Goals	Improve management of sensors and water utility's response to metering faults
Actors	System operation staff
Description	The system provides information on the accuracy (manufacturer values) of the sensors and searches for (systematic or accidental) faults by analysing measurements of neighbouring sensors (installed downstream and upstream). In the case of a suspected fault, the system raises a warning for the specific metering device and flags the faulty measurements. As an option, the system also takes into account results from the simulation model to improve fault detection capability.
Pre-conditions	• Availability of real-time data from sensors. • Availability of the topology of the system. • Availability of information on technical specifications of the sensors.
Post-conditions	System operation staff gets information on the status of the sensors and warnings in the case of suspected faulty measurements.
Data source	• Real-time data from sensors (both new sensors and those of the legacy SCADA system). • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility.

	• Information on technical specifications of sensors, provided by water utility • Estimations of flow from simulation.
Trigger	Operation staff requests information on the status of the sensors or the system detects faults in a sensor.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of flow conditions. • Unavailability of information on technical specifications of the sensors • Unavailability of numerical estimations from the simulation scheme
Main flow	• System operation staff logs on to the system • The system displays information on the status of sensors • The system raises a warning in the case of a suspected faulty measurement.
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02

Table 23: GR.EYDAP.SA1.US02.UC02: Receive warnings about unusual flow conditions

Unique ID and use case name	GR.EYDAP.SA1.US02.UC02: Receive warnings about unusual flow conditions
Domain	Water utility
Goals	Improve the water utility's response to unusual flow conditions in the conveyance system.
Actors	System operation staff
Description	System operation staff obtains warnings associated with unusual flow conditions in the conveyance system. These may concern flow measurements from sensors that exceed specific minimum or maximum thresholds or unusual/abnormal rates of change in the flow over time or space (i.e., between different locations of the system). Thresholds and rates of change are defined as unusual/abnormal based on current operational conditions, as specified by the operator.
Pre-conditions	• Availability of real-time data from sensors.

	• Availability of the topology of the system. • Availability of the location of sensors. • Availability of information and reference values for the flow regime in the conveyance system under different operating conditions. • Availability of information on current operating conditions.
Post-conditions	System operation staff receives warnings
Data source	• Real-time data from sensors (both new sensors and those of the legacy SCADA system). • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility. • Information on current operating conditions of the system, provided by water utility.
Trigger	Occurrence of an unusual event.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of flow conditions. • Availability of information in the operating conditions of the system
Main flow	• Operation staff receives a warning • Operation staff logs on to the system • System provides information on the detected event and the causes of it • Operation staff validates or not the warning
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA1.US02.UC05

Table 24: GR.EYDAP.SA1.US02.UC03: Obtain information on water losses

Unique ID and use case name	GR.EYDAP.SA1.US02.UC03: Obtain information on water losses
Domain	Water utility
Goals	Improve understanding and management of water losses.
Actors	System operation staff

Description	The platform by analysing the mass balance (difference between inflow and outflow) of the conveyance system provides estimation on water losses. The user can obtain overall information for the entire system or focus on the water losses exhibited in specific parts by selecting the upstream and downstream sensor. The platform allows the analysis of water losses on the basis of different temporal levels (e.g., hourly, daily, monthly, annually) and for different time periods in order to reveal the variation over time and possible trends. To provide meaningful information the estimations are presented both in the form of volumes of water as well as of percentages of inflows.
Pre-conditions	• Availability of historical data. • Availability of the location of sensors. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections).
Post-conditions	Operation staff gets information on water losses of the system
Data source	• Historical data from water utility's database (from both new sensors and those of the legacy SCADA system) • Topology of the conveyance system, provided by water utility. • Location of the sensors, provided by water utility.
Trigger	Operation staff requests access to information on water losses.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the topology of the system. • Unavailability of information on the location of sensors. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of flow conditions.
Main flow	• System operation staff logs on to the system • System operation staff selects the option for water losses understanding • System operation staff selects data processing options • System operation staff selects data visualisation options • The system processes data and make calculations according to selected options • System operation staff accesses to data • The system presents a report with the obtained data

	• System operation staff can print the report, save data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 25: GR.EYDAP.SA1.US02.UC04: Obtain estimations of future water demand volumes

Unique ID and use case name	GR.EYDAP.SA1.US02.UC04: Obtain estimations of future water demand volumes
Domain	Water utility
Goals	Provide estimations of future water demand volumes based on past historical demand data.
Actors	System operation staff
Description	The platform enables the user to access, process and analyse historical water demand records to obtain estimations for future water volumes. The user is able to specify the temporal resolution of analysis (e.g., on hourly, daily, monthly basis) and time period of interest (e.g., working days, weekend days, summer months, winter months, Easter holidays). For the selected options, the platform presents summary statistics of water volumes via explanatory graphs and reports. Depending on the availability of data, the estimation of water volumes can be also conducted on the basis of different type of users. For a specific water volume estimation, the user can also request information on the optimal sluice gate settings (see Use Cases GR.EYDAP.SA1.US03.UC01 and P1.GR1.EYDAP.US03.UC02).
Pre-conditions	• Availability of historical water demand data at different spatial and temporal scales.
Post-conditions	System operation staff gets the required information.
Data source	• Historical water demand data, provided by water utility
Trigger	System operation staff requests information on water volumes
Constraints	• Short sample of historical data (record of length smaller than 5 year) not allowing to inference on the differentiation of water demand between different seasons (winter – summer) and to support the estimation of demand of specific events and time periods (e.g., Easter period)
Main flow	• System operation staff logs on to the system

	• System operation staff selects the options for the estimations of water volumes • System operation staff selects data processing options such as the temporal resolution of analysis and the time period • The system processes data and make calculations according to selected options • System operation staff accesses to information • The system presents a report with the obtained data • System operation staff can print the report, save data or escape the application • The operation staff can request the optimal sluice gate setting for the estimated demand
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA1.US03.UC01 , GR.EYDAP.SA1.US03.UC02

Table 26: GR.EYDAP.SA1.US03.UC01 Get support on sluice gates operational settings

Unique ID and use case name	GR.EYDAP.SA1.US03.UC01: Get support on the sluice gate opening
Domain	Water utility
Goals	Support water utility to establish specific flow conditions
Actors	System operation staff
Description	The platform provides support regarding the opening of sluice gates to establish specific flow conditions in the conveyance system. This functionality is implemented via the hydraulic model of the conveyance system which allows the user to configure and evaluate alternative simulation scenarios. Specifically, the user specifies the target flow at a specific point of the system and provides the boundary conditions (i.e., stage upstream, stage downstream, current gate opening, flow measurement downstream, etc.). The platform performs the simulation and presents the optimal sluice gate(s) setting(s).
Pre-conditions	• Availability of flow data at the downstream point of interest. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections). • Availability of information on the characteristics of sluice gates.

	• Availability of information on the initial status of sluice gate(s) setting(s) (initial conditions). • Availability of stage measurements upstream and downstream of the relevant sluice gates. • Definition of target flow. • Availability of simulation model to run the scenario.
Post-conditions	System operation staff gets suggestions on the optimal sluice gate settings.
Data source	• Flow data from the sensors at the downstream point of interest. • Topology of the system (length of channels, characteristics and geometry of cross-sections), provided by water utility. • Characteristics of sluice gates. • Information on the initial status of sluice gate(s) setting(s) (initial conditions), provided by water utility. • Stage measurements upstream and downstream of the relevant sluice gates.
Trigger	System operation staff requests suggestions for the optimal sluice gate settings.
Constraints	• Low accuracy of the sensors or false measurements for the flow downstream • Unavailability of data at a specific point of the conveyance system. • Unavailability of information regarding the characteristics of sluice gates.
Main flow	• System operation staff logs on to the system • System operation staff requests suggestions on sluice gate control • System operation staff configures the scenarios • Simulation model runs the scenarios and the platform displays the results • System operation staff accesses the results • System operation staff can print the report, save data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA1.US03.UC02

Table 27: GR.EYDAP.SA1.US03.UC02: Get support on the scheduling of sluice gate operation

Unique ID and use case name	GR.EYDAP.SA1.US03.UC02: Get support on the scheduling of sluice gate operation
Domain	Water utility
Goals	Support water utility regarding the optimal scheduling of sluice gates of the conveyance system.
Actors	System operation staff
Description	The platform enables the operator to get information on the time required for a change in the flow at an upstream (sluice gate) point to be established at a specific point downstream. This time essentially determines the scheduling of the sluice gates, i.e., how many hours before should the opening of a sluice gate(s) take place to establish a specific flow condition at a specific point downstream. This functionality is implemented via the hydraulic simulation model of the conveyance system which allows the user to configure and evaluate alternative simulation scenarios. Specifically, the user defines upstream and downstream points of interest, and the change in the flow at the upstream point (sluice gate).
Pre-conditions	• Availability of flow data at the downstream point of interest. • Availability of stage measurements at the downstream point of interest. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections). • Availability of information on the characteristics of sluice gates. • Availability of stage at the points upstream and downstream. • Availability of information on the initial status of sluice gate opening (initial conditions). • Availability of simulation model to run the scenario
Post-conditions	System operation staff obtains the requested information
Data source	• Flow data from the sensors at the downstream point of interest. • Topology of the system (length of channels, characteristics and geometry of cross-sections), provided by water utility. • Characteristics of sluice gates. • Information on the initial status of sluice gate(s) setting(s) (initial conditions), provided by water utility.

	• Stage measurements upstream and downstream of the relevant sluice gates.
Trigger	System operation staff requests suggestions on the required time for the establishment of a specific flow condition at a downstream point of the system
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of stage data at the point of interest • Unavailability of information regarding the characteristics of sluice gates.
Main flow	• System operation staff logs on to the system • System operation staff requests information for the "travel time of flow" • System operation staff configures the initial conditions and specifies the point of interest • Simulation model runs the scenarios and the platform displays the results • System operation staff accesses the results • System operation staff can print the report, save data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA1.US03.UC01

V.1.ii. Water quality early-warning application

Table 28: GR.EYDAP.SA2.US01.UC01: Obtain real-time information on water quality

Unique ID and use case name	GR.EYDAP.SA2.US01.UC01: Obtain real-time information on water quality
Domain	Water utility
Goals	Monitor the quality of water in the conveyance system on a real-time basis
Actors	Water quality control staff, WTP operators
Description	Water utility gets access to water quality data (e.g., turbidity / conductivity / temperature) on a real-time basis from the installed sensors in the water conveyance system, via the web platform. The homepage of the platform

	provides real-time overview information on the current water quality of the conveyance system. Furthermore, the platform enables the user to monitor the entire under-study part of system through a graphical interface (digital representation of the system), while by pointing a specific sensor the user gets access to the real-time data at the corresponding location. The user can specify the quality parameter of interest, while the system supports different ways of visualisation of the measurements such as time series charts, tables and reports.
Pre-conditions	• Availability of real-time data from sensors. • Availability of the location of sensors.
Post-conditions	System operation staff gets the requested real-time data
Data source	• Real-time data from quality sensors. • Location of the sensors, provided by water utility.
Trigger	System operation staff requests access to real-time water quality data
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the location of sensors.
Main flow	• User logs on to the system via an authentication procedure • Platform displays the facilities available to the user • User selects the options related to the real-time monitoring of the quality in conveyance system. • User selects data processing and visualisation options (e.g., location, temporal scale) • System processes data according to the selected options and displays the results • User accesses to data, can print a report, save the data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 29: GR.EYDAP.SA2.US01.UC02: Get access and analyse historical quality data

Unique ID and use case name	GR.EYDAP.SA2.US01.UC02: Get access and analyse historical quality data

Domain	Water utility
Goals	Get access, process and analyse historical water quality measurements from the sensors of the conveyance system.
Actors	Water quality control staff, WTP operators
Description	Water utility gets access to historical water quality data (turbidity / conductivity / temperature) from the sensors in the water conveyance system, via the web platform. The user, via the graphical interface, can request access to the historical data of a single sensor (location) for further processing and analysis. The system provides the flexibility to the user to determine the quality parameter of interest, the temporal resolution (e.g., instant, hourly mean, daily mean etc.) and the time period of interest. The system displays meaningful information and statistics (e.g., trends, peaks) for the under study measurements aiming to improve user's understanding on the variation of quality parameter over time (rate of change over time). Furthermore, the user is able to request comparative information regarding the historical data of different time periods as well as between different locations to monitor the variation over space. The system supports different ways of visualisation for the presented information such as time series charts, tables and reports.
Pre-conditions	• Availability of historical data. • Availability of the location of sensors.
Post-conditions	System operation staff gets the requested information
Data source	• Historical quality data from water utility's database. • Location of the sensors, provided by water utility.
Trigger	System operation staff requests access to overall information on the water quality of raw water
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the location of sensors. • Short sample of historical data (record of length smaller than 1 year) not allowing to capture the seasonal variability of water quality parameters.
Main flow	• User logs on to the system via an authentication procedure • User selects the options related to information on the quality of water in the system • User defines the parameters of the temporal and spatial analysis and the time window of measurements.

	• System processes data according to the selected options and displays the results • User accesses to data and can print a report, save the data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 30: GR.EYDAP.SA2.US02.UC01: Obtain information on the operating status of sensors

Unique ID and use case name	GR.EYDAP.SA2.US02.UC01: Obtain information on the operating status of sensors
Domain	Water utility
Goals	Improve supervision of sensors and water utility's response to metering faults
Actors	Water quality control staff, WTP operators
Description	The platform enables the supervision of the quality sensors installed in the conveyance system, providing information on their operating status and presenting additional information (e.g., battery level, signal strength, technical specs) for the metering device. In the case of a malfunction (e.g., no transmission of measurements for a long time span), the system raises warning pointing the suspected device. Furthermore, the system also searches for metering faults in the devices (e.g., systematic fluctuations, systematic missing values etc.) by analysing the readings of the sensors. In the case of a suspected fault, the system raises warning for the specific metering device and flags the faulty measurement(s).
Pre-conditions	• Availability of real-time data from sensors. • Availability of the location of the sensors. • Availability of information on technical specifications of the sensors. • Availability of additional data from sensors further to measurements.
Post-conditions	System operation staff gets information on the status of the sensors and warnings in the case of malfunctions.
Data source	• Real-time data from sensors. • Location of the sensors, provided by water utility.

	• Information on technical specifications of sensors, provided by water utility. • Real-time data from sensors further to the quality measurements.
Trigger	Operation staff requests information on the status of the sensors or the system detects faults in a sensor or its measurement(s).
Constraints	• Unavailability of information on technical specifications of the sensors
Main flow	• System operation staff logs on to the system. • The system displays information on the status of sensors. • The system raises a warning in the case of malfunctions or faulty measurement(s).
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 31: GR.EYDAP.SA2.US02.UC02: Receive information and warnings about unusual quality events

Unique ID and use case name	GR.EYDAP.SA2.US02.UC02: Receive information and warnings about unusual quality events
Domain	Water utility
Goals	Improve water utility's understanding and response to unusual quality events in the conveyance system
Actors	Water quality control staff, WTP operators
Description	System operation staff receives warnings and alerts associated with unusual quality events in the system, on a real-time basis. The platform informs the user if a measurement at a specific point of the conveyance system exceed a maximum threshold (e.g., if turbidity exceeds 1000 NTU). If a similar high measurement is also detected at the neighbouring sensors downstream, then the platform alerts the user for a possible "travelling" of the event to WTP. The platform, further to warning, presents information on the location and time of the occurrence of the event as well as the estimation of the time required to reach the WTP (see GR.EYDAP.SA2.US02.UC03).
Pre-conditions	• Availability of real-time data from quality sensors. • Availability of the location of quality sensors. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections).

	• Availability of information and reference values for the quality parameter thresholds. • Availability of information on flow conditions.
Post-conditions	System operation staff receives warnings about unusual quality events.
Data source	• Real-time data from quality sensors. • Location of the sensors, provided by water utility. • Topology of the conveyance system, provided by water utility. • Rea-time data from flow sensors. • Thresholds for quality parameters, provided by water utility.
Trigger	System operation staff receives warnings about unusual quality events in the system.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the location of sensors.
Main flow	• Operation staff receives a warning on an unusual high measurement or changes in water quality parameters among different locations. • Operation staff logs on to the system. • System provides information on the detected event and details on it. • Operation staff validates or not the warning.
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC03

Table 32: GR.EYDAP.SA2.US02.UC03: Obtain information on the time needed for a quality event to travel downstream

Unique ID and use case name	GR.EYDAP.SA2.US02.UC03: Obtain information on the time needed for a quality event to travel downstream
Domain	Water utility
Goals	Improve the water utility's response on unusual water quality events.
Actors	Water quality control staff, WTP operators
Description	The platform enables the user to estimate the time needed for a quality event to travel from one location to another. To accomplish this, the platform uses real-time measurements from flow sensors to estimate the

	velocities at the different parts of the conveyance system. The system presents the overall time until the WTP, while the user can request access to information per segment of the conveyance system. The above process is activated automatically if an unusual quality event is detected and validated by the user (GR.EYDAP.SA2.US02.UC02) to provide its “travel time”. When the travel time is lower than a specified distance (e.g., 3-hours), additional warning alert are sent to the WTP.
Pre-conditions	• Availability of real-time data from quality sensors. • Availability of the location of quality sensors. • Availability of the topology of the system (length of channels, characteristics and geometry of cross-sections). • Availability of flow measurements.
Post-conditions	System operation staff receives information on the travel-time of an event.
Data source	• Real-time data from quality sensors. • Location of the sensors, provided by water utility. • Topology of the conveyance system, provided by water utility. • Rea-time data from flow sensors.
Trigger	The user asks information for the travel-time of an event or an unusual event has been detected.
Constraints	• Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • Unavailability of information on the location of sensors.
Main flow	• Operation staff receives a warning about unusual and high turbidity measurement. • Operation staff logs on to the system. • System provides information on the time needed for the event to reach specific points downstream
Alternative flow	• User logs on to the system via an authentication procedure • User requests information on travel times in the conveyance system • System processes data according to the selected options and displays the results • User accesses to data, can print a report, save the data or escape the application
Issues	N/A

Relationship with other use cases	GR.EYDAP.SA2.US02.UC02

V.2. Use cases for Demo Case #2. Cannes (France)

This section presents the use cases for the FIWARE-compliant Smart Water applications for the Cannes demo case.

In Cannes demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.2). The use cases of “Production and transport” are presented in Section V.2.i, while those of “Distribution” in Section V.2.ii.

V.2.i. Production and transport

Table 33: FR.3S.SA1.US01.UC01: Forecast water resources availability during summertime

Unique ID and use case name	FR.3S.SA1.US01.UC01: Forecast water resources availability during summertime
Domain	Water utility
Goals	Monitor and forecast the availability of water resources during summertime.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	Each year, at the end of spring, operators want to know the availability of each water resource for the coming summer, from 15 June to 15 September. They wish to use a model that calculates automatically the forecasts of the availability of each water resource during the summer. 1. The operator defines the simulation context for the model in a dialog box: – **Water resources:** selection of one, several or all water resources on a georeferenced map or in a list. – **Forecast period:** definition of the start and end dates using a calendar (the default forecast period is from June 15 to September 15). – **Long-term weather forecasts** (rainfalls and temperatures) for the coming summer. Selection of one of the three proposed sources of information: ▪ A weather server (check beforehand the existence of weather forecasts provided over a period of at least 3 months). ▪ A list of predefined weather scenarios stored in the AQUAVANCED® Water Networks database.

	▪ A past year with associated real weather data from the region stored in the AQUAVANCED® Water Networks database. 2. The operator clicks on a button to calculate the availability forecasts of the selected water resources over the defined summer period. The update period for these forecasts would be bi-monthly or monthly. The display facilities are described in the use case FR.3S.SA1.US01.UC02 "Display water resources availability forecasts". 3. These functions must be available in AQUAVANCED® Water Networks. 4. If the water resource availability forecasts calculated by the model prove to be relevant, one can imagine connecting this model to the AQUAVANCED® Water Networks module in charge of calculating in real time the possible withdrawals from each water resource (see topic "Constraints" below).
Pre-conditions	• Availability, completeness and reliability of real-time data from sensors (e.g. rain gauges, temperatures and water resources availability). • Existence and reliability of long-term weather forecasts (rainfalls and temperatures) for the coming summer (3 months).
Post-conditions	• Deliver a relevant forecast model (black box model), which assumes a significant correlation between weather conditions in past winters and springs and the availability of water resources in the associated summers.
Data source	• Weather data and water resources availability data should be stored in the AQUADVANCED® Water Networks database. • Data for the machine learning phase (used to build the model in differed time from historical data sets): – Rainfalls and temperatures of past winters, springs and summers – Water resources availability of past winters springs and summers (for each water resource) • Data for the computation phase (used to run the model in real time): – Rainfalls and temperatures of the past winter and spring – Long-term rainfalls and temperatures forecasts for the coming summer
Trigger	• Operators do not have a model for forecasting the availability of water resources for the coming summer, even though they have already been confronted with periods of drought leading to water stress on water resources.

Constraints	• Neither river hydraulic model nor hydrogeological model exists for the SICASIL drinking water supply system. • SUEZ Eau France must comply with two prefectural constraints assigned to each water resource: – The **water right** (in French: "droit d'eau"): an authorization specifying the maximum volume of water that SUEZ Eau France is allowed to withdraw. – The **reserved flow** (in French: "débit réservé"): the minimum flow value of the resource to be complied with after water withdrawal. Strict compliance with this constraint during periods of drought sometimes requires that this resource no longer be used; in such situations, alternative water resources must then be used.
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• The availability forecasts for selected water resources, for the coming summer period, in order to: – Identify resources that may be under water stress. – Feed the AQUAVANCED® Water Networks module in charge of calculating in real time the possible withdrawals from each water resource.
Relationship with other use cases	• Predecessors: None • Successors: FR.3S.SA1.US01.UC02 "Display water resources availability forecasts"

Table 34: FR.3S.SA1.US01.UC02: Display water resources availability forecasts

Unique ID and use case name	FR.3S.SA1.US01.UC02: Display water resources availability forecasts
Domain	Water utility
Goals	Display water availability forecasts for the coming summer period.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	1. Once the availability forecasts of a water resource have been calculated (see the use case FR.3S.SA1.US01.UC01 "Forecast water resources availability during summertime"), the following information is displayed by default on the same graph: – Its availability over the past winter and spring (real measurements) – Its availability for the coming summer (forecasted by the associated model) 2. For each water resource, display on the previous graph the following additional information selected by the operator: – Rainfalls and/or temperatures of the past winter and spring – Long-term weather forecasts (rainfalls and/or temperatures) considered, for the simulation, for the coming summer 3. These functions must be available in AQUAVANCED® Water Networks.
Pre-conditions	• Weather data and water resources availability data stored in the AQUADVANCED® Water Networks database.
Post-conditions	• A user friendly and ergonomic graphical user interface so that operators make an operational use of this business service.
Data source	• Weather data and water resources availability data should be stored in the AQUADVANCED® Water Networks database. • Data for the machine learning phase (used to build the model in differed time from historical data sets): – Rainfalls and temperatures of past winters, springs and summers – Water resources availability of past winters springs and summers (for each water resource) • Data for the computation phase (used to run the model in real time): – Rainfalls and temperatures of the past winter and spring – Long-term rainfalls and temperatures forecasts for the coming summer
Trigger	• Operators need to work with an ergonomic software.

Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• The water resource availability forecasts and additional information displayed for each water resource.
Relationship with other use cases	• Predecessors: FR.3S.SA1.US01.UC01 "Forecast water resources availability during summertime" • Successors: None

Table 35: FR.3S.SA1.US02.UC01: Forecast water demand

Unique ID and use case name	FR.3S.SA1.US02.UC01: Forecast water demand
Domain	Water utility
Goals	Forecast the water demand for each water consumption area.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	Operators wish to use a model that calculates, automatically and in real time, the forecasts of the water demand for each water consumption area. 1. Different parameters must be set to define the simulation context for each model. These parameters are configured before deployment on site and are rarely changed afterwards: – **Forecast time horizon (FTH):** It is the future time horizon on which the water demand forecast is computed, typically one week ahead (e.g. from 15/10/19 at 06:00 to 16/10/19 at 06:00 (this parameter must be configurable). – **Forecast time step (FTS):** It is the time period between two forecast instants in the forecast horizon, typically 30mn or 60mn (e.g. 15:10/19 at 06:00, 06:30, 07:00, 07:30, … ,23:00, 23:30 and 16/10/19 at 00:00) (this parameter must be configurable). – **Forecast update frequency (FUF):** It is the frequency at which the water demand forecast is updated, i.e. recomputed, typically every 30mn or 60mn (this parameter must be configurable). These three parameters are independent. – Example: FTH = 1 week, FTS = 30mn and FUF = 60mn

	– Explanations: The water demand forecast is computed over a time horizon of one week ahead, with a time step of 30 minutes inside this time horizon. And this forecast is updated every hour. 2. This function must be available in AQUAVANCED® Water Networks. Water demand forecasts are updated at the FUF frequency. This function must also improve the performance of the existing function in this software.
Pre-conditions	• Availability, completeness and reliability of real-time data from sensors (e.g. past water consumptions) or weather data (e.g. past and weather forecast).
Post-conditions	• Deliver a relevant and reliable forecast model (black box model) to meet water demands of water consumption areas.
Data source	• Meteorological parameters: – Current and past temperatures over the last two weeks – Temperature forecasts over two weeks – Etc. • Public holiday agenda • Data about tourist numbers • Current and past water consumptions over one or two weeks of each water consumption area stored in the AQUADVANCED® Water Networks database
Trigger	• Cannes basin is located in the South of France; it is an area subject to high tourist activity during the Cannes Film Festival in May and during the summer period. It is therefore important to calculate forecasts accurately to meet water demands of water consumption areas.
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• The water demand forecast for each water consumption area.
Relationship with other use cases	• Predecessors: None • Successors: None

V.2.ii. Distribution

Table 36: FR.3S.SA2.US01.UC01: Collect data

Unique ID and use case name	FR.3S.SA2.US01.UC01: Collect data
Domain	Water utility
Goals	Collect data from the following two data sources: ORTOMAT acoustic sensors and InflowSens™ high-frequency pressure sensors.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	The combined use of different types of sensors can significantly improve leak detection in the drinking water distribution network. (e.g. acoustic sensors, sectorization flow meters, automated meter reading, high-frequency pressure sensors). 1. The need is to collect measurements from the following two data sources: – ORTOMAT acoustic sensors / noise loggers (manufacturer: VON ROLL): – InflowSens™ high-frequency pressure sensors (manufacturer: Inflowmatix): 2. These functions must be available in AQUAVANCED® Water Networks.
Pre-conditions	• Easy and reliable access to data stored in clouds. • Efficient and reliable data import from clouds to AQUADVANCED® Water Networks.
Post-conditions	• Stable data storage format for the duration of the Fiware4Water project.
Data source	• Two types of sensors whose data are stored on clouds: – ORTOMAT acoustic sensors (manufacturer: VON ROLL) – InflowSens™ high-frequency pressure sensors (manufacturer: Inflowmatix)
Trigger	• VON ROLL: – SUEZ Eau France (French subsidiary of SUEZ in the water sector) has signed a framework agreement with the manufacturer VON ROLL for noise loggers. • Inflowmatix: – Founded in 2015 as a spin-out from Imperial College London, Inflowmatix is the world leader in high-frequency pressure data management and analysis technology for water operators.

	– In October 2019, SUEZ acquired a minority stake in Inflowmatix and thus strengthened its range of digital solutions to optimise the performance and resilience of drinking water networks.
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• Hydraulic measurements collected from the following two data sources: ORTOMAT acoustic sensors and InflowSens™ high-frequency pressure sensors. • Measurements imported in AQUADVANCED® Water Networks and stored in its database.
Relationship with other use cases	• Predecessors: None • Successors: FR.3S.SA2.US01.UC02 "Detect water leaks" FR.3S.SA2.US01.UC04 "Detect fast hydraulic transients"

Table 37: FR.3S.SA2.US01.UC02: Detect water leaks

Unique ID and use case name	FR.3S.SA2.US01.UC02: Detect water leaks
Domain	Water utility
Goals	Detect automatically abnormal water quality events.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	1. Operators also want to detect, automatically water leak in the drinking water distribution network, based on different hydraulic measurements. 2. Each detected event is displayed on a georeferenced map or in a time-stamped events list. 3. These functions must be available in AQUAVANCED® Water Networks. It must improve the performance of the existing functions in this software.
Pre-conditions	• Availability and reliability of real-time data from sensors (e.g. flow rates and pressures).
Post-conditions	• Deliver a relevant and reliable forecast model (black box model) to detect water leaks.
Data source	• Hydraulic data stored in the AQUADVANCED® Water Networks database.

Trigger	• Cannes basin is located in the South of France; it is an area subject to drought episodes. SUEZ Water France, in charge of operating this system, must improve the network's performance by reducing water leaks and show that the company is taking actions aiming at preserving water resources.
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• Leaks automatically detected by detection models. Three detection modes are distinguished: – Single-parameter models detecting automatically leaks from each type of sensor (one model per type of sensor). – A global model detecting automatically leaks by combining the decisions provided by the above single-parameter models (e.g. based on the majority vote) – A global multi-parameter model detecting automatically leaks from several types of sensors.
Relationship with other use cases	• Predecessors: FR.3S.SA2.US01.UC01 "Collect data" • Successors: FR.3S.SA2.US01.UC03 "Improve decision making"

Table 38: FR.3S.SA2.US01.UC03: Improve decision making

Unique ID and use case name	FR.3S.SA2.US01.UC03: Improve decision making
Domain	Water utility
Goals	Improve and make the decision of the operator suspecting a leak more reliable by displaying the necessary and sufficient information.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	This use case aims at contributing to: – Establish a faster and more reliable diagnosis of the existence of a leak – Accelerate decision making – Better analyse the state of a hydraulic sector The operator's decision regarding the existence or not of a leak on a pipe is based on the examination of many different pieces of information.

	The dispersion of this information in different graphical views of a software program, or worse in graphical views of different software programs, makes the operator's decision making more complex and slower. The main objective of this use case is to reduce the number of irrelevant events (i.e. not related to leak detection) by providing the operator with the necessary and sufficient information, from a single graphical view, to decide whether or not there is a leak. 1. Identify and specify the pieces of information to be displayed to the operator about the detected event: – Hydraulic: ▪ Night flow ▪ Daily volume ▪ Flow rate put into distribution ▪ Combined flowmeters – Asset: ▪ Linear network concerned (one sector or a few surrounding sectors?) ▪ Memos associated to the sector – Interventions and complaints: ▪ List of interventions and complaints in the sector ▪ Click to display the specific and detailed view of interventions and complaints – Acoustic sensors: ▪ Indicators pointing out sensors on alert ▪ Click to display a simplified view of the acoustic sensors 2. Identify and specify the graphical modalities (bar graphs, time series, pie charts, etc.) with which this information will be displayed to the operator. 3. These functions must be available in AQUAVANCED® Water Networks. They must improve the performance of the existing functions in this software.
Pre-conditions	• Availability of all identified data to be displayed on the single graphical view.
Post-conditions	• A user friendly and ergonomic graphical user interface so that operators make an operational use of this business service.
Data source	• The AQUADVANCED® Water Networks database.

Trigger	• Dispersing information in different graphical views of a software, or worse in graphical views of different softwares, to decide whether or not there is a leak, makes the operator's decision making more complex and slower.
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• A mock-up of the graphical view. • An informative graphical view available in AQUADVANCED® Water Networks.
Relationship with other use cases	• Predecessors: FR.3S.SA2.US01.UC02 "Detect water leaks" • Successors: None

Table 39: FR.3S.SA2.US01.UC04: Detect fast hydraulic transients

Unique ID and use case name	FR.3S.SA2.US01.UC04: Detect fast hydraulic transients
Domain	Water utility
Goals	Preserve the assets of the network by detecting fast hydraulic transients.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	Recurrent hydraulic transients (e.g. water hammer) can cause damage to the network. It is therefore important to be able to detect these hydraulic events in order to protect the existing assets. 1. A first need is to detect fast hydraulic transients from signals provided by high-frequency pressure sensors. 2. Each detected event is displayed on a georeferenced map or in a time-stamped events list. 3. Each detected event is characterized by parameters (e.g. duration, intensity, spectrum, etc.). 4. Identify the sensors that have observed the same hydraulic transient and use them to locate the cause of the event. 5. These functions must be available in AQUADVANCED® Water Networks.
Pre-conditions	• Availability, completeness and reliability of real-time data from sensors.

Post-conditions	• Deliver a relevant and reliable forecast model (black box model) to detect fast hydraulic transients.
Data source	• The AQUADVANCED® Water Networks database.
Trigger	• Recurrent hydraulic transients (e.g. water hammer) can cause damage to the network
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• Fast hydraulic transients detected and characterized automatically and in real time.
Relationship with other use cases	• Predecessors: FR.3S.SA2.US01.UC01 "Collect data" • Successors: None

Table 40: FR.3S.SA2.US02.UC01: Collect data

Unique ID and use case name	FR.3S.SA2.US02.UC01: Collect data
Domain	Water utility
Goals	Collect data from quality sensors and/or multi-parameter probes to monitor water quality in the distribution network.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	The development and testing of algorithms for the automatic detection of abnormal water quality events requires historical data sets (see the use case FR.3S.SA2.US02.UC02 "Detect abnormal water quality events"). The PROTEUS multi-parameter probe will not be installed in the drinking water distribution network of SICASIL, at best, until the beginning of the third year of the project. This late date will not allow building a one-year historical data sets incorporating seasonal variations. As the exhaustiveness of the data will not be guaranteed in these conditions, the detection algorithms cannot be developed from the PROTEUS probe data. There are currently no water quality measurements on the SICASIL distribution network. Therefore, it is important to install, in the network, as soon as possible quality sensors or multi-parameter probes, other than

	the PROTEUS probe (see "Data source" section below), in order to collect measurements and build up historical data sets as exhaustive as possible. 1. A study will be carried out to identify the optimal positioning of water quality sensors and/or multi-parameter probes in the SICASIL drinking water distribution network. 2. These devices will be installed in the distribution network. The TOPKAPI SCADA (editor: AREAL) will be configured to automatically collect the measurements in real time. They will then be automatically imported into AQUADVANCED® Water Networks and stored in its database.
Pre-conditions	N/A
Post-conditions	N/A
Data source	• Water quality data collected from various sensors and multi-parameter probes, depending of devices to be deployed on the distribution network: – One or several prototypes of PROTEUS multi-parameter probe (designed by CNRS and packaged by EGM). Probably not available before the third year of the project. – 1 spectrolyser probe (manufacturer: scan) provided by TZW (to be confirmed). – 1 panel with traditional sensors (pH, electrical conductivity, turbidity, redox) provided by TZW (to be confirmed). – 4 nanostations (manufacturer: scan) provided by SUEZ / CIRSEE. These are multi-parameter probes measuring 7 parameters: pH, temperature, conductivity, free chlorine, UV254, TOC and turbidity – 5 or 6 multi-parameter probes: pipescans or nanostations (manufacturer: scan). – SICASIL could launch a restricted consultation to implement quality probes (5 or 6) on their network. This scenario is not certain. 3S is waiting for a feedback from the Côte d'Azur Agency of SUEZ Eau France, in charge of operating the SICASIL network.
Trigger	• Quality monitoring in the distribution network has been a topic of discussion for several years but has had difficulty emerging because of the very high cost of multi-parameter probes. This is the main reason why networks are not currently instrumented. • The prices evoked for the PROTEUS probe would be very significantly lower than those of the market, which would allow their massive deployment on distribution networks and the development of new business services associated with water quality monitoring.

Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• Water quality sensors or multi-parameter probes installed in the SICASIL drinking water distribution network. • Measurements collected into the TOPKAPI SCADA. • Measurements imported from TOPKAPI to AQUADVANCED® Water Networks.
Relationship with other use cases	• Predecessors: None • Successors: FR.3S.SA2.US02.UC02 "Detect abnormal water quality events"

Table 41: FR.3S.SA2.US02.UC02: Detect abnormal water quality events

Unique ID and use case name	FR.3S.SA2.US02.UC02: Detect abnormal water quality events
Domain	Water utility
Goals	Monitor the water quality in the distribution network and detect automatically, in real time, abnormal water quality events.
Actors	The operation staff of the local "Côte d'Azur" Agency of SUEZ Eau France.
Description	1. Operators wish to monitor in real time the water quality in the distribution network from quality sensors and/or multi-parameter probes. After selecting a sensor or multi-parameter probe on a georeferenced map or from a sensors list, the operator displays the time series associated with the quality parameter(s). 2. Operators also want to detect, automatically and in real time, abnormal water quality events (e.g. pollution), based on available quality measurements. 3. Each detected event is displayed on a georeferenced map or in a time-stamped events list. 4. These functions must be available in AQUAVANCED® Water Networks. They must improve the performance of the existing functions in this software. **Optional:** 5. The propagation of pollution in the network is a requirement expressed by the operators. A hydraulic model (for conservative

	parameters) or a quality model (for non-conservative parameters) makes it possible to see, in real time, the propagation and concentration of pollution in the network. 6. The localisation of the cause of a pollution (e.g. by triangulation of measurements) is an important requirement but it is a subject considered complicated and very closely linked to the number and density of sensors installed in the network (which will probably be low at the pilot site). 7. These functions must be available in AQUAVANCED® Water Networks.
Pre-conditions	• Availability, completeness and reliability of real-time data from water quality sensors and multi-parameter probes.
Post-conditions	N/A
Data source	• Water quality measurements stored in the AQUADVANCED® Water Networks database.
Trigger	N/A
Constraints	N/A
Main flow	See topic "Description" above.
Alternative flow	N/A
Outcomes	• Abnormal water quality events detected, automatically and in real time, from one or several quality sensors and/or multi-parameter probes.
Relationship with other use cases	• Predecessors: FR.3S.SA2.US02.UC01 "Collect data" • Successors: None

V.3. Use cases for Demo Case #3. Amsterdam (the Netherlands)

This section presents the use cases for the FIWARE-compliant WWTP optimisation application for the Amsterdam demo case.

Table 42: NL.WNT.SA1.US01.UC01: Obtain near real-time validated sensor data of the WWTP research lane

Unique ID and use case name	NL.WNT.SA1.US01.UC01: Obtain near real-time validated sensor data of the WWTP research lane
Domain	Process technologist (PT) and process operators (PO)
Goals	Validate data from the WWTP research lane sensors.
Stakeholders	PTs, POs, management

Description	The PT receives near real-time data that has been validated. The system receives measured parameters via sensors and actuators at different locations of the plant. Sensor and actuator readings are checked (a) on data validity,(b) are provided with warnings when anomalies are detected and (c) are corrected whenever possible and tagged. Both the raw and corrected sensor readings can be visualised.
Pre-conditions	• Data infrastructure is operational • Platform connected to legacy systems • Availability of newly installed sensor readings • Method to check for the data validity • Method to identify, correct and tag anomalous sensor signals
Post-conditions	The user (PT) receives the requested information.
Data source	• Water utility's database or a previously installed system (legacy system) to provide time series / historical data of measured data. • Water utility's information about sensor and actuator specifications • Water utility's information on the layout of the treatment plant and treatment lanes
Trigger	Lack of validated data of the WWTP research lane. Therefore, the PT requests the near real-time validated data (history).
Constraints	Availability, reliability and accuracy of sensors and actuators, i.e. • Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • (Un)availability of information on technical specifications of the sensors and actuators.
Main flow	• PT logs on to his personal profile using a private password • PT selects the visualisation options related to the corrected and raw sensor data. • PT selects whether a report with the obtained information and data should be generated • PT can print or export the report, save/export data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 43: NL.WNT.SA1.US01.UC02: Understand the performance of the WWTP research lane

Unique ID and use case name	NL.WNT.SA1.US01.UC02: Understand the performance of the WWTP research lane
Domain	Process technologist (PT) and process operators (PO)
Goals	Monitor greenhouse emissions, energy costs, water quality and their determining factors associated to the functioning and performance of the WWTP research lane enabling analysis and evaluation on a near real-time basis
Stakeholders	PTs, POs, management
Description	The system monitors the current performance and status of the WWTP by measuring parameters via sensors and actuators at different locations of the plant. These measurements are fused with a WWTP model which is able to derive observable and non-observable process variables and key performance indicators. Relations between process conditions, nitrous oxide emissions and energy use based on sensor and soft-sensor data are learnt by a.o. machine learning techniques and these relations will be incorporated in the WWTP model. Process variables and key performance indicators aim to improve the understanding of the current status of the WWTP performance, and consist of e.g.: • An overview of different loads (N, O2, CO2, CH4) in standardised units • Nitrification capacity (rate) • Oxygen uptake rate • Nitrogen, oxygen and carbon balance (sludge) • The quantity and distribution of sludge • Distribution of water and air flow over different lanes and variables that relate to greenhouse emissions, energy costs and the water quality.
Pre-conditions	• Data infrastructure is operational • Platform connected to legacy systems • Availability of newly installed sensor readings • Method to check for the data validity • Method to correct and tag anomalous sensor signals • Method to estimate important process variables (WWTP soft sensor) using (known) infrastructure topology, balance equations and sensor data

	• Method to train the model relations between process conditions, nitrous oxide emissions and energy use soft sensor; • Calculation method for greenhouse gas emissions, energy costs and determining factors • Tariffs for energy costs
Post-conditions	The user (PT) receives the requested information.
Data source	• Water utility's database or a previously installed system (legacy system) to provide time series / historical data of measured data. • Water utility's information about sensor and actuator specifications • Water utility's information on the layout of the treatment plant and treatment lanes
Trigger	Lack of information about the (current) performance of the WWTP and its determining factors. Therefore, the PT requests near real-time information about the current status of the WWTP regarding greenhouse emissions, energy costs and water quality.
Constraints	Availability, reliability and accuracy of sensors and actuators, and the quality of data presented by the system, i.e.: • Differences in data granularity throughout the system and in time. • Low accuracy of the sensors or false measurements. • (Un)availability of information on technical specifications of the sensors and actuators. • (Un)availability of numerical estimations from the WWTP soft sensor • (Un)availability of information regarding the operational conditions of the system
Main flow	• PT logs on to his personal profile using a private password • PT selects the visualisation options related to the performance indicators and/or observable and non-observable process variables. PT selects whether a report with the obtained information and data should be generated • PT can print or export the report, save/export data or escape the application
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	N/A

Table 44: NL.WNT.SA1.US01.UC03: Short-term forecast the process behaviour and performance of the WWTP research lane

Unique ID and use case name	NL.WNT.SA1.US01.UC03: Short-term forecast the process behaviour and performance of the WWTP research lane
Domain	PT and PO
Goals	Predictions of greenhouse gas emissions, energy costs and water quality such that the near-future performance of the WWTP can be estimated
Stakeholders	PTs, POs, management
Description	The system predicts the performance of the WWTP using a data driven model that estimates observable and non-observable process variables and key performance indicators.
Pre-conditions	• Data infrastructure is operational • Platform connected to legacy systems • Availability of newly installed sensor readings • Definition of data validation and (standardised) data exchange methods • Data-based method to check and verify the integrity of sensors • Method to estimate process variables (WWTP model) • Calculation method for greenhouse gas emissions, energy costs and determining factors • Tariffs for energy costs
Post-conditions	The PT receives information about the predicted status of the WWTP regarding greenhouse emissions, energy costs and water quality.
Data source	• Water utility's database or a previously installed system (legacy system) to provide time series / historical data of measured data. • Water utility's information about sensor and actuator specifications • Water utility's information on the layout of the treatment plant and treatment lanes • External data sources, e.g. historical and forecasted weather data
Trigger	Lack of information about the future performance of the WWTP and its determining factors. Therefore, the PT requests information about the predicted status of the WWTP regarding greenhouse emissions, energy costs and water quality.
Constraints	Availability, reliability and accuracy of sensors, actuators and external data (sources), and the quality of data (internal and external) presented by the system.

Main flow	• PT logs on to his personal profile using a private password • PT selects the visualisation options related to the performance indicators and/or observable and non-observable process variables. PT selects whether a report with the obtained information and data should be generated • PT can print or export the report, save/export data or escape the application. • the PT can request and view forecasted data.
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	NL.WNT.SA1.UC01, NL.WNT.SA1.UC02

Table 45: NL.WNT.SA1.US01.UC04: control of the processes and performance of the WWTP research lane

Unique ID and use case name	NL.WNT.SA1.US01.UC04: control of the processes and performance of the WWTP research lane
Domain	PT and PO
Goals	**(High level) optimal control** regarding greenhouse gas emissions, energy costs and water quality such that (long term) performance (optimisation) criteria can be evaluated and modified if needed.
Stakeholders	PTs, POs, management
Description	The system determines control settings for optimal performance of the WWTP using historical, current and forecasted data. The system enables users to compare performance and tune the desired performance in terms of greenhouse gas emissions, energy costs and water quality.
Pre-conditions	• Data infrastructure is operational • Platform connected to legacy systems • Availability of newly installed sensor readings • Definition of data validation and (standardised) data exchange methods • Data-based method to check and verify the integrity of sensors • Method to estimate process variables (WWTP model) • Calculation method for greenhouse gas emissions, energy costs and determining factors • Tariffs for energy costs

	• Method to forecast process variables from data for the research lane • (Definition of) decision variables, control strategies, control settings and settings for optimisation criteria • Method to forecast process variables and key performance indicators from data for the research lane
Post-conditions	• The PT receives information about the control settings of the WWTP regarding greenhouse emissions, energy costs and water quality. • Controller output data (that can be fed into the legacy control system)
Data source	• Water utility's database or a previously installed system (legacy system) to provide time series / historical data of measured data. • Water utility's information about sensor and actuator specifications • Water utility's information on the layout of the treatment plant and treatment lanes • External data sources, e.g. historical and forecasted weather data.
Trigger	The PT requests to have an optimised performance of the WWTP regarding greenhouse gas emissions, energy costs and water quality because current state of the art control systems are not able to cope with the complexity of the WWTP processes and stochastic events in the future.
Constraints	Availability, reliability and accuracy of sensors and actuators, implementation of an optimal, model-based controller, the quality and quantity of data fed to the system and the performance of the controller within the system.
Main flow	• PT logs on to his personal profile using a private password • PT selects the visualisation options related to the performance indicators and/or observable and non-observable process variables. PT selects whether a report with the obtained information and data should be generated • PT can print or export the report, save/export data or escape the application. • the PT can request and view forecasted data. • the PT selects the options related to the control settings and settings for optimisation criteria. • PT can print or export the report, save/export data or escape the application
Alternative flow	N/A
Issues	N/A

Relationship with other use cases	NL.WNT.SA1. US01.UC01, NL.WNT.SA1. US01.UC02, NL.WNT.SA1.US01.UC03

V.4. Use cases for Demo Case #4. Great Torrington (UK)

In Great Torrington demo case, FIWARE-compliant applications for smart metering systems are going to be developed, targeting both the water utility and consumer domain (see Section II.4). The use cases for the water utility domain are presented in Section V.4.i, while those for the consumer domain in Section V.4.ii.

V.4.i. Water utility domain

Table 46: UK.SWW.SA1.US01.UC01: Obtain water consumption data from smart metered households

Unique ID and use case name	UK.SWW.SA1.US01.UC01: Obtain water consumption data from smart metered households
Domain	Billing, Customers, Water Efficiency
Goals	Secure, reliable and scalable platform for the utility to retrieve, store and integrate daily consumption data with legacy systems, i.e. billing systems.
Actors	Water Utility
Description	The system monitors the total water consumption at the household scale based on consumption data from daily smart meters (multiple formats/suppliers) and traditional 6 monthly manual reads. Data from multiple sources and formats is reconciled (e.g. data from daily or monthly consumption is expressed in the same format and can be compared/combined, etc.). The data is captured and integrated with the utilities corporate systems (distribution system control and billing systems). Goals: • The daily consumption is captured or profiled from latest meter transmission • A totalised water consumption of the previous day, week, month, year (or date period specified by the user), can be retrieved. • A flexible system that can adapt to differing data frequencies, i.e. daily vs. 15min consumption data and interpolate where data points are missing
Pre-condition	• Availability of water consumption data from smart metering systems. • IoT communications network. • Database to store consumption data

Post-condition	• Ability for water utility to view consumption data for all smart meters
Data source	• Smart meters at household level to provide daily consumption data (multiple formats / suppliers including Sigfox and Temetra) • Standard meter reading data from corporate systems (includes AMR)
Trigger	Consumption data (from smart meters and historic data from loggers) available to FIWARE
Constraints	• Availability of accurate consumption data • FIWARE connection to Sigfox • Integration with legacy water company systems including automatic file sharing
Main flow	• Install communications network • Householder engaged in the project • Install household smart meter • Utility receives daily consumption data and is able to integrate within its corporate systems for billing, etc.
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	Required for all other cases

Table 47: UK.SWW.SA1.US02.UC01 Leak alarms from smart meters

Unique ID and use case name	UK.SWW.SA1.US02.UC01 Leak alarms from smart meters
Domain	Water Efficiency, Leakage, Supply Demand

Goals	Obtain and process daily leak alarms from customer meters
Actors	Water Utility
Description	In-built leak alarms from the meters are processed alongside the consumption data. The data is captured and integrated with the utilities corporate systems (distribution system control and billing systems). The system is flexible to accommodate leak alarms from different device types. A history of leak alarms from individual devices can be recalled. The water utility can add comments to each meter The water utility can suppress alarms for a selected durations (1wk, 1mth, 6mth, 1yr)
Pre-condition	• Availability of leak alarm data from the smart meters • Database. • IoT communications network.
Post-condition	• Water utility can view leak alarms for smart metered regions • Water utility can manage alarms in an application • Water utility can implement work management processes in application (e.g. leak alarm -> leak detection staff deployed -> suppress alarm until leak fixed)
Data source	• Smart meters at household level to provide in-built leak alarm data
Trigger	Leak alarm data (from smart meters)
Constraints	• Availability of leak alarm data • FIWARE connection to Sigfox
Main flow	• User logs in and can retrieve all meters with leak alarms • The user can select meters to view based on suspected volumes or locations • A history of leak alarms for each meter is viewed • Comments are submitted against the alarm • If necessary, leak detection staff are deployed • Or, the leak alarm is suppressed for the selected duration
Alternative flow	N/A

Issues	N/A
Relationship with other use cases	Case UK.SWW.SA1.US02.UC02 – it is expected that leak alarms (directly from the meters) and suspected leak alerts (from data analysis) are presented in the same application

Table 48: UK.SWW.SA1.US02.UC02 Suspected leak alerts from analysis of smart data

Unique ID and use case name	UK.SWW.SA1.US02.UC02 Suspected leak alerts from analysis of smart data
Domain	Water Efficiency, Leakage, Supply Demand
Goals	Identify suspected leaks at individual meters based on the daily consumption data that has been captured and processed previously
Actors	Water Utility
Description	The system monitors the total water consumption at the household scale based on consumption data from daily smart meters (multiple formats/suppliers). Data from multiple sources and formats is reconciled (e.g., data from daily or monthly consumption is expressed in the same format and can be compared/combined, etc.). The data is analysed to determine suspected leaks, i.e., by looking for small variance in the daily data indicating continuous flows or from a change in use patterns resulting in continuously large water use A history of leak alerts from individual devices can be recalled. The water utility can add comments to each meter The water utility can suppress alerts for a selected durations (1wk, 1mth, 6mth, 1yr)
Pre-condition	• Availability of water consumption data from smart metering systems. • IoT communications network. • Processing and storing of data (refer to case 1)
Post-condition	• Water utility can view leak alerts for smart metered regions • Water utility can manage alarms in an application • Water utility can implement work management processes in application (e.g. leak alert -> leak detection staff deployed -> suppress alert until leak fixed)
Data source	• Consumption data received, processed and stored from case 1.

Trigger	Consumption data is analysed and determined to be a pattern indicating the potential for a leak
Constraints	• Availability of accurate consumption data • FIWARE connection to Sigfox • Integration with legacy water company systems
Main flow	• User logs in and can retrieve all meters with leak alerts • The user can select and filter by suspected leak volume and/or location • A history of leak alerts for each meter can be retrieved • Comments can be submitted against each meter • If necessary, leak detection activities are scheduled • Leak alerts can be suppressed • Leak detection feedback can be provided – this information is used to update the algorithm
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	Case UK.SWW.SA1.US02.UC01 - it is expected that leak alarms (from meters) and suspected leak alerts (from data analysis) are presented in the same application

Table 49: UK.SWW.SA1.US02.UC03 Triaging consumption data with other time series data (e.g. rainfall data)

Unique ID and use case name	UK.SWW.SA1.US02.UC03 Triaging consumption data with other time series data (e.g. rainfall data)
Domain	Water Efficiency, Leakage, Supply Demand
Goals	Development of a single platform to view and explore relationships between time series data and consumption data
Actors	Water Utility
Description	Data from multiple sources and formats is reconciled (e.g., data from daily or monthly consumption is expressed in the same format and can be compared/combined, etc). The spatially relevant time series data is displayed for each meter The user can toggle on and off other data sets within a single time series view, e.g., daily temperatures
Pre-condition	• Availability of other time series data and their spatial properties

	• Database to store consumption data and time series data
Post-condition	• At least 1 other time series dataset is available in the same application as the consumption data
Data source	• Smart meters at household level to provide daily consumption data (multiple formats / suppliers including Sigfox and Temetra) • Standard meter reading data from corporate systems (includes AMR)
Trigger	Consumption data (from smart meters and historic data from loggers) available to FIWARE
Constraints	• Availability of other time series data and relevant spatial properties
Main flow	• User logs into portal • User selects meter of interest • Daily time series consumption data is presented to the user • The user has ability to toggle on and off other spatially relevant time series datasets • Graphs and charts are interactive and have export to image functionality • Multiple meters can be selected and their daily consumption is summed for display
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	Case UK.SWW.SA1.US01.UC01 – other time series will be available alongside consumption data from case 1a

V.4.ii. Consumer domain

Table 50: UK.SWW.SA2.US01.UC01 Application for customers to view their consumption data

Unique ID and use case name	UK.SWW.SA2.US01.UC01: Application for customers to view their consumption data
Domain	Billing, Customer Relations, Water Efficiency
Goals	Secure and reliable platform for household customers to access their water consumption data
Actors	Domestic Customer (billed for drinking water)
Description	The system monitors the total water consumption at the household scale based on consumption data from daily smart meters (multiple formats/suppliers) and traditional 6 monthly manual reads.

	The data is presented individually to each customers via an online portal. The consumption data is presented in both litres and pounds (gbp) and is dependent on the customers tariff, i.e., water only or sewerage. Goals: • The daily consumption is captured or profiled from latest meter transmission • A totalised water consumption of the previous day, week, month, year (or date period specified by the user), can be retrieved. • A flexible system that can adapt to differing data frequencies, i.e., daily vs. 15min consumption data. • Consumption is used to calculate the cost to user (bill) depending on their tariff.
Pre-condition	• Availability of water consumption data from smart metering systems. • IoT communications network. • Database to store consumption data
Post-condition	• A smart phone application is made available on Google play allowing customers to view their consumption
Data source	• Smart meters at household level to provide daily consumption data (multiple formats / suppliers including Sigfox and Temetra) • Standard meter reading data from corporate systems (includes AMR)
Trigger	Consumption data (from smart meters and historic data from loggers) available to FIWARE. User access to portal.
Constraints	• Availability of accurate consumption data • FIWARE connection to Sigfox • Integration with legacy water company systems
Main flow	• Householder signs up to online portal • Householder accesses their daily consumption data • Householder views their consumption and bill for any period of time desired
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	Case UK.SWW.SA1.US01 - customers will be presented with consumption data

Table 51: UK.SWW.SA2.US02.UC01 Access to consumption data makes positive impact on customers water use behaviour

Unique ID and use case name	UK.SWW.SA2.US02.UC01 Access to consumption data makes positive impact on customers water use behaviour
Domain	Household Customer
Goals	Engagement with the customer to help them manage their water consumption
Actors	Domestic Customer (billed for drinking water),
Description	The system monitors the total water consumption at the household scale based on consumption data from daily smart meters (multiple formats/suppliers). Analysis is undertaken and comparative statistics are provided to the user based on neighbours, social groups, property characteristics, etc. Leak alerts are provided to the customers based on the utilities analysis of the data (see previous use case) High consumption alerts can be setup by the customer to informed them when a certain volume (or monetary value) of water is consumed over a pre-defined period.
Pre-condition	• Availability of water consumption data from smart metering systems. • IoT communications network. • Processing and storing of data (refer to case 1) • Initial comparative daily consumption data by social group/property/occupancy/etc.
Post-condition	• On the same smart phone application as developed in Case 3a, the user will be able to set high consumption alerts, be notified of leaks, and can compare their consumption to other customers (e.g. of the same family size, location etc.). The user will also be able to submit their specific information, i.e., occupancy rate, and compare their consumption against similar customers.
Data source	• Consumption data received, processed and stored from case 1a.
Trigger	Consumption data is analysed and determined to be a pattern indicating the potential for a leak or high consumption
Constraints	• Availability of accurate consumption data • FIWARE connection to Sigfox

	• Integration with legacy water company systems
Main flow	• Householder signs up to online portal • Householder accesses their daily consumption data • Householder views their consumption and bill for any period of time desired • Householder is provided with comparative information about their consumption • Householder sets a budget and format for communication if budget exceeded, i.e., weekly budget with exceedance communicated via the app and via email. • Householder provides specific consumption information, i.e., property occupancy rate, and is able to compare their consumption to similar customers (or a pre-defined profile).
Alternative flow	N/A
Issues	N/A
Relationship with other use cases	This case extends the functionality of Case UK.SWW.SA2.US01

VI. Requirements of the systems

VI.1. Methodology overview

With the list of use cases for the FIWARE-compliant Applications at hand, the next step concerns the articulation of system requirements to be passed in the design of the Fiware4Water system architecture (WP2) and the development of Smart Applications (WP3).

The derivation of system requirements supports the more in-depth understanding and description of the functionalities of the systems as initially described via the use cases. According to Robertson and Robertson [5], with respect to a service development, a requirement describes an individual, specifically document need that this service has to fulfil.

Based on the functionalities described via lower-level use cases, the specification of requirements is based on the following three types [4]:

- **Functional requirements**: Things the system must do, that source from user goals.
- **Non-functional requirements**: Qualities and properties that the system must have, e.g. performance, reliability, fault tolerance, frequency, priority.
- **Data requirements**: It covers aspects such as required data for the system and access to information.

VI.2. Requirements identification procedure and template

Having established the final set of use cases and their detailed description (Step 4 in the procedure presented in Figure 5), the above three types of requirements are identified for each individual use case. The initial set of system requirements is composed before the 3rd workshop by the local research partner for the relevant applications. In order to ensure a common language and form of requirements across the 4 demo cases, a standardised procedure is proposed and followed. Initially, the verbal description of the requirements was conducted for each lower-level use case. This procedure describes the interaction between the system and the user (actor) on the basis of the following two statements [6]:

- The <*stakeholder/user*> shall be able to <*capability of the system*>.
- The <*system*> shall be able to <*function*>.

The textual description of the identified requirements is then standardised in the form of a spreadsheet to allow the identification of overlapped requirements between different use cases, supporting the establishment of a single list of requirements per FIWARE-compliant Smart Water Application.

Similarly to use cases, a common template is composed and employed for the identification and description of the system requirements of the FIWARE-compliant Smart Water Applications at all four demo cases. Following the successful paradigm from relevant recent developments, e.g., in the framework of iWIDGET project [2], we establish a spreadsheet template where each requirement is defined by the following fields [4]:

- **Use Case ID:** The use case(s) from which the requirement is derived.
- **Requirement ID:** It is the unique identifier that specifies the enumeration, type of requirement, possibly includes traces from its source e.g. use case number. A continuous numbering is used for the functional (e.g., Fn.001, Fn.002 etc.), non-functional (e.g., N-Fn.001, N-Fn.002 etc.) and data requirements (D-Fn.001, D-Fn.002 etc.).
- **Requirements Type:** It specifies the type of the requirement according to the above three types, i.e. Functional, Non-Functional, Data.
- **Requirement Short Description:** Short title for the requirement, enabling a brief understanding of the content.
- **Requirement Details:** Detail but comprehensive description of the requirement, as given by the two sentences used in the textual description.
- **Demo Case:** It specifies the demo case that raises the requirement.

A screenshot of the template used for the standardization of requirements is presented in Figure 6.

Use Case ID	Req. ID: Fn.n, Nfn.n or Dfn.n	Req. Type: Functional, Non-Functional or Data	Requirement Short Description	Requirement Details	Demo Case
WP1.GR1.EYDAP.US01.UC01	Fn.001	Functional	Authentication Procedure	The user shall be able to log on his personal profile using a password and a username.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.002	Functional	Request real-time information	The user shall be able to request real-time water flow data from the sensors in the conveyance system.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.003	Functional	Selection of sensors	The user shall be able to select the point (sensor) of interest in the conveyance system.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.004	Functional	Selection of units	The user shall be able to select the units of the presented information (e.g., water flow, water depth, flow velocity, volumes of water).	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.005	Functional	Selection of time period	The user shall be able to specify a past time point until the last available information (time period of interest).	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.006	Functional	Selection of multiple sensors	The user shall be able to select multiple points (sensors) for a parallel real-time monitoring.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.007	Functional	Print information	The user shall be able to print the real-time information.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.008	Functional	Download information	The user shall be able to download the real-time information.	EYDAP

Figure 6: Template for requirements identification

Both textual description and the corresponding spreadsheet was revisited by the utility during the 3rd workshop and the final tables of functional, non-functional and data requirements were established.

The guide and the template that were composed to ensure consistency in the description of system requirements across the four demo cases is given in Annex B.

VI.3. System Requirements for Demo Case #1. Athens (Greece)

In Athens demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.1). The list of requirements for the use cases of "water quantity routing application" are presented in Section VI.3.i, while the requirements of "water quality early-warning application" in Section VI.3.ii.

VI.3.i. Water quantity routing application

Table 52: List of requirements for the "Water quantity routing application"

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.001	Functional	Authentication Procedure	The user shall be able to log on his personal profile using a password and a username.	EYDAP
GR.EYDAP.SA1.US01.UC01	Fn.002	Functional	Request real-time flow information	The user shall be able to request real-time water flow data from the sensors in the conveyance system.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03	Fn.003	Functional	Selection of sensors	The user shall be able to select the point (sensor) of interest in the conveyance system.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02	Fn.004	Functional	Selection of units	The user shall be able to select the units of the presented	EYDAP

				information (e.g., water flow, water depth, flow velocity, volumes of water).	
GR.EYDAP.SA1.US01.UC01	Fn.005	Functional	Selection of time period	The user shall be able to specify a past time point until the last available information (time period of interest).	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02	Fn.006	Functional	Selection of multiple sensors	The user shall be able to select multiple points (sensors) for a parallel real-time monitoring.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.007	Functional	Print information	The user shall be able to print the information.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.008	Functional	Download information	The user shall be able to download the information.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US03.U	D-Fn.001	Data	Obtain requested real-time flow data	The system shall obtain real-time flow data from the local database.	EYDAP

C01, GR.EYDAP.SA1.US03.UC02					
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.002	Data	Obtain information on the conveyance system	The system shall obtain information on the location of the sensors and the topology of the conveyance system.	EYDAP
GR.EYDAP.SA1.US01.UC01	Fn.009	Functional	Execute calculations	The system shall execute the appropriate calculations (e.g., unit transformation).	EYDAP
GR.EYDAP.SA1.US01.UC01	Fn.010	Functional	Display real-time flow information	The system shall display the requested real-time information.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	EYDAP

GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	N-Fn.002	Non-Functional	Ease of use	The system shall have easy-to-use design for the user.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	N-Fn.003	Non-Functional	Ease of interpretation	The system shall have provided clear and easily-accessible information.	EYDAP
GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01	Fn.011	Functional	Request access to historical flow data	The user shall be able to request access to historical flow data.	EYDAP
GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC03	Fn.012	Functional	Selection of time interval	The user shall be able to specify the time period of interest for the presented information.	EYDAP
GR.EYDAP.SA1.US01.UC01, GR.EYDAP.SA1.US01.UC02, GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.003	Data	Obtain requested historical flow data	The system shall obtain historical flow measurements from the local database.	EYDAP

GR.EYDAP.SA1.US01.UC02	Fn.013	Functional	Execute analysis on historical flow data	The system shall execute the appropriate calculations for the statistics and information to be displayed.	EYDAP
GR.EYDAP.SA1.US01.UC02	Fn.014	Functional	Display information on past flows	The system shall display the requested information and statistics.	EYDAP
GR.EYDAP.SA1.US02.UC01	Fn.015	Functional	Request information on operating status of sensors	The user shall be able to request information on the status of sensors.	EYDAP
GR.EYDAP.SA1.US02.UC01	Fn.016	Functional	Request information on the accuracy of measurements	The user shall be able to request manually information on the accuracy of measurements.	EYDAP
GR.EYDAP.SA1.US02.UC01	D-Fn.004	Data	Obtain information on the technical specifications of sensors	The system shall obtain information on the technical specifications of sensors.	EYDAP
GR.EYDAP.SA1.US02.UC01, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.005	Data	Obtain requested data from the simulation model	The system shall obtain flows from the simulation model.	EYDAP
GR.EYDAP.SA1.US02.UC01	Fn.017	Functional	Execute analysis for faulty measurements	The system shall execute the appropriate calculations for the detection of systematic or accidental faults in measurements.	EYDAP
GR.EYDAP.SA1.US02.UC01	Fn.018	Functional	Display operating status of sensors	The system shall display information on the operating status of sensors.	EYDAP
GR.EYDAP.SA1.US02.UC01	Fn.019	Functional	Raise warning for faulty measurements	The system shall raise and display warnings for faulty measurements.	EYDAP
GR.EYDAP.SA1.US02.UC02	Fn.020	Functional	Execute analysis for unusual flow	The system shall execute the appropriate calculations for the detection of unusual flow conditions.	EYDAP

GR.EYDAP.SA1.US02.UC02	Fn.021	Functional	Raise warning for unusual flow	The system shall raise and display warnings for unusual flow conditions.	EYDAP
GR.EYDAP.SA1.US02.UC02, GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.006	Data	Obtain information on the operating conditions	The system shall obtain information on the operating conditions of the conveyance system.	EYDAP
GR.EYDAP.SA1.US02.UC02	D-Fn.007	Data	Obtain reference values and thresholds for flow	The system shall obtain thresholds and reference values for the flows.	EYDAP
GR.EYDAP.SA1.US02.UC03	Fn.022	Functional	Request information on water losses	The user shall be able to request information on the water losses in the conveyance system.	EYDAP
GR.EYDAP.SA1.US02.UC03, GR.EYDAP.SA1.US02.UC04	Fn.023	Functional	Selection of temporal level of analysis	The user shall be able to specify the temporal level of analysis (daily, monthly, annually).	EYDAP
GR.EYDAP.SA1.US02.UC03	Fn.024	Functional	Execute analysis for water losses	The system shall execute the appropriate calculations for the calculations of water losses in the conveyance system.	EYDAP
GR.EYDAP.SA1.US02.UC03	Fn.025	Functional	Display information on water losses	The system shall display the information on water losses in the conveyance system.	EYDAP
GR.EYDAP.SA1.US02.UC03	Fn.026	Functional	Request information on future water demand volumes	The user shall be able to request estimations for the future water demand volumes.	EYDAP
GR.EYDAP.SA1.US02.UC04	D-Fn.008	Data	Obtain demand data	The system shall obtain water demand measurements.	EYDAP
GR.EYDAP.SA1.US02.UC04	Fn.027	Functional	Execute analysis for future demand estimation	The system shall execute the appropriate calculations for the estimation of future water demand volumes.	EYDAP
GR.EYDAP.SA1.US02.UC04	Fn.028	Functional	Display information on future demands	The system shall display the information on the	EYDAP

				future water demand volumes.	
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.029	Functional	Request information for sluice gate settings	The user shall be able to request suggestions on sluice gate settings.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.030	Functional	Selection of target flow	The user shall be able to specify the target flow.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.031	Functional	Selection of point of interest	The user shall be able to specify the point of interest (where the target flow is to be established).	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.032	Functional	Configure simulation scenarios	The user shall be able to configure the scenario to be simulated.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.009	Data	Obtain characteristics of sluice gates	The system shall obtain information on the characteristics of the sluice gates.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.010	Data	Obtain the status of sluice gates	The system shall obtain information on the status of the sluice gates (initial conditions).	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.011	Data	Obtain target flow	The system shall obtain information on the target flow.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	D-Fn.012	Data	Execute simulation of flow	The system shall execute the simulation to estimate the flow and the sluice gate settings.	EYDAP
GR.EYDAP.SA1.US03.UC01, GR.EYDAP.SA1.US03.UC02	Fn.033	Functional	Display information from simulation scenarios	The system shall display the information from the simulation scenarios.	EYDAP
GR.EYDAP.SA1.US03.UC02	Fn.034	Functional	Request information for sluice gate scheduling	The user shall be able to request suggestions on the scheduling of sluice gate operation.	EYDAP
GR.EYDAP.SA1.US03.UC02	Fn.035	Functional	Display information on sluice gate scheduling	The system shall display the information for sluice gate scheduling.	EYDAP

VI.3.ii. Water quality early-warning application

Table 53: List of requirements for the "Water quality early-warning application"

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	Fn.001	Functional	Authentication Procedure	The user shall be able to log on his personal profile using a password and a username.	EYDAP
GR.EYDAP.SA2.US01.UC01	Fn.002	Functional	Request real-time quality information	The user shall be able to request real-time water quality data from the sensors in the conveyance system.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	Fn.003	Functional	Selection of sensors	The user shall be able to select the point (sensor) of interest in the conveyance system.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02	Fn.004	Functional	Selection of quality parameters	The user shall be able to select the quality parameter to be presented (e.g., turbidity/conductivity/temperature).	EYDAP
GR.EYDAP.SA2.US01.UC01	Fn.005	Functional	Selection of time period	The user shall be able to specify a past time point until the last available information (time period of interest).	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02	Fn.006	Functional	Selection of multiple sensors	The user shall be able to select multiple points (sensors) for a parallel real-time monitoring.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	Fn.007	Functional	Print information	The user shall be able to print the information.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	Fn.008	Functional	Download information	The user shall be able to download the information.	EYDAP

GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.001	Data	Obtain requested real-time quality data	The system shall obtain real-time quality data from the local database.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.002	Data	Obtain information on the location of quality sensors	The system shall obtain information on the location of quality sensors.	EYDAP
GR.EYDAP.SA2.US01.UC01	Fn.009	Functional	Execute calculations	The system shall execute the appropriate calculations (e.g., unit transformation).	EYDAP
GR.EYDAP.SA2.US01.UC01	Fn.010	Functional	Display real-time quality information	The system shall display the requested real-time information.	EYDAP
GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01	Fn.011	Functional	Request access to historical quality data	The user shall be able to request access to historical quality data.	EYDAP
GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC03	Fn.012	Functional	Selection of time interval	The user shall be able to specify the time period of interest for the presented information.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.003	Data	Obtain requested historical quality data	The system shall obtain quality measurements from the local database.	EYDAP
GR.EYDAP.SA2.US01.UC02	Fn.013	Functional	Execute analysis on historical quality data	The system shall execute the appropriate calculations for the statistics and information to be displayed.	EYDAP
GR.EYDAP.SA2.US01.UC02	Fn.014	Functional	Display information on past quality data	The system shall display the requested information and statistics.	EYDAP
GR.EYDAP.SA2.US02.UC01	Fn.015	Functional	Request information on operating status of quality sensors	The user shall be able to request information on the status of quality sensors.	EYDAP
GR.EYDAP.SA2.US02.UC01	Fn.016	Functional	Request information on the accuracy of measurements	The user shall be able to request manually information on the accuracy of measurements.	EYDAP
GR.EYDAP.SA2.US02.UC01	D-Fn.004	Data	Obtain information on the technical specifications of sensors	The system shall obtain information on the technical specifications of sensors.	EYDAP

GR.EYDAP.SA2.US02.UC01	D-Fn.005	Data	Obtain additional data from the quality sensors	The system shall obtain additional data from the quality sensors (e.g., battery level, signal strength, technical specs).	EYDAP
GR.EYDAP.SA2.US02.UC01	Fn.017	Functional	Execute analysis for faulty measurements	The system shall execute the appropriate calculations for the detection of systematic or accidental faults in measurements.	EYDAP
GR.EYDAP.SA2.US02.UC01	Fn.018	Functional	Display operating status of sensors	The system shall display information on the operating status of sensors.	EYDAP
GR.EYDAP.SA2.US02.UC01	Fn.019	Functional	Raise warning for faulty measurements	The system shall raise and display warnings for faulty measurements.	EYDAP
GR.EYDAP.SA2.US02.UC02	Fn.020	Functional	Execute analysis for unusual quality events	The system shall execute the appropriate calculations for the detection of unusual quality events.	EYDAP
GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	Fn.021	Functional	Raise warnings and display information on unusual quality events	The system shall raise and display warnings for unusual quality events.	EYDAP
GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.006	Data	Obtain information on the operating conditions	The system shall obtain information on the operating conditions of the conveyance system.	EYDAP
GR.EYDAP.SA2.US02.UC02	D-Fn.007	Data	Obtain reference values and thresholds for quality parameters	The system shall obtain thresholds and reference values for the quality parameter thresholds.	EYDAP
GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.008	Data	Obtain flow measurements	The system shall obtain flow measurements from the local database.	
GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	D-Fn.009	Data	Obtain information on the conveyance system	The system shall obtain information on the location of flow sensors and the topology of the conveyance system.	
GR.EYDAP.SA2.US02.UC03	Fn.022	Functional	Request information on travel times	The user shall be able to request information on travel times in the conveyance system.	EYDAP
GR.EYDAP.SA2.US02.UC03	D-Fn.010	Data	Obtain information on unusual quality events	The system shall obtain information for detected unusual quality events.	EYDAP
GR.EYDAP.SA2.US02.UC03	Fn.023	Functional	Execute analysis for the estimation of travel time	The system shall execute the appropriate calculations for the	EYDAP

				estimation of travel-times in the conveyance system.	
GR.EYDAP.SA2.US02.UC03	Fn.024	Functional	Display information on travel times	The system shall display the travel-time of an event.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	N-Fn.002	Non-Functional	Ease of use	The system shall have easy-to-use design for the user.	EYDAP
GR.EYDAP.SA2.US01.UC01, GR.EYDAP.SA2.US01.UC02, GR.EYDAP.SA2.US02.UC01, GR.EYDAP.SA2.US02.UC02, GR.EYDAP.SA2.US02.UC03	N-Fn.003	Non-Functional	Ease of interpretation	The system shall have provide clear and easily-accessible information.	EYDAP

VI.4. System Requirements for Demo Case #2. Cannes (France)

In Cannes demo case, two different FIWARE-compliant Smart Water Applications are going to be developed (see Section II.2). The use cases of “Production and transport” are presented in Section V.2.i, while those of “Distribution” in Section V.2.ii.

VI.4.i. Production and transport

Table 54: List of requirements for the “Production and transport”

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
FR.3S.SA1.US01.UC.01	Fn.001	Functional	User (Water Utility) configures the calculation context of water resources availability forecasts	The user shall be able to configure, in a dialog box, the calculation context of water resources availability forecasts during summertime (from June 15 to September 15): (i) Water resources, (ii) Forecast period and (iii) Long-term weather forecasts (rainfalls and temperatures) for the	SUEZ

				coming summer. Default values are configured at the start of use, but they can be changed manually later by the IT integrator.	
FR.3S.SA1.US01.UC.01	Fn.002	Functional	System calculates availability forecasts for each water resource	The system shall be able to automatically calculate availability forecasts for each water resource during the summer. Calculations are performed in accordance with the calculation context defined in Fn.001.	SUEZ
FR.3S.SA1.US01.UC.01	Dfn.001	Data	System feeds the module managing water withdrawals from water resources	The system shall be able to feed, automatically and in real-time, the existing module of AQUAVANCED® Water Networks in charge of managing in real-time the possible withdrawals from water resources, with the forecasts calculated in Fn.002. SUEZ Eau France must comply with two prefectural constraints assigned to each water resource: (i) Water right (in French: "droit d'eau") and (ii) Reserved flow (in French: "débit réservé").	SUEZ
FR.3S.SA1.US01.UC.01	Nfn.001	Non-functional	Context of use	Fn.001, Fn.002 and Dfn.001 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ

FR.3S.SA1.US01.UC.02	Fn.003	Functional	User (Water Utility) launches the calculation of water resources availability forecasts	The user shall be able to launch the calculation of availability forecasts (see Fn.002) by clicking on a button in the dialog box described in Fn.001.	SUEZ
FR.3S.SA1.US01.UC.02	Fn.004	Functional	User (Water Utility) requests the display of availability forecasts of a water resource	The user shall be able to request the display of availability forecasts of a water resource (see Fn.005), according to one of the two following modalities: (i) Select the water resource on a georeferenced map and (ii) Select the water resource from a list of water resources.	SUEZ
FR.3S.SA1.US01.UC.02	Fn.005	Functional	System displays availability forecasts of a water resource	The system shall be able to display, on the same graph, the two following time series associated with a water resource: (i) Its availability over the past winter and spring (real measurements) and (ii) Its availability for the coming summer (forecasts calculated by the model - see Fn.002).	SUEZ
FR.3S.SA1.US01.UC.02	Fn.006	Functional	System displays additional information about availability forecasts of a water resource	The system shall be able to display selectively, on the same graph defined in Fn.005, one or several of the following time series associated with a water resource: (i) Rainfalls and/or temperatures of the past winter and spring and (ii) Long-term weather forecasts	SUEZ

				(rainfalls and/or temperatures).	
FR.3S.SA1.US01.UC.02	Nfn.002	Non-functional	Context of use	Fn.003 to Fn.006 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ
FR.3S.SA1.US02.UC.01	Fn.007	Functional	IT integrator configures the calculation context of water demand forecasts	User (Water Utility) shall be able to configure, for each water consumption area, the calculation context of water demand forecasts: (i) Forecast time horizon, (ii) Forecast time step and (iii) Forecast update frequency (FUF). Default values are configured at the start of use, but they can be changed manually later by the IT integrator.	SUEZ
FR.3S.SA1.US02.UC.01	Fn.008	Functional	System calculates water demand forecasts for each water consumption area	The system shall be able to calculate, automatically and in real-time, water demand forecasts for each water consumption area. Calculations are performed in accordance with the calculation context defined in Fn.007.	SUEZ
FR.3S.SA1.US02.UC.01	Fn.009	Functional	System displays water demand forecasts of a water consumption area	The system shall be able to display water demand forecasts of a water consumption area (see Fn.008).	SUEZ

FR.3S.SA1.US02.UC.01	Nfn.003	Non-functional	Context of use	Fn.007 to Fn.009 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ

VI.4.ii. Distribution

Table 55: List of requirements for the "Distribution"

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
FR.3S.SA2.US01.UC.01	Dfn.002	Data	System collects measurements from two data sources: ORTOMAT acoustic sensors and InflowSens high-frequency pressure sensors	The system shall be able to automatically collect measurements from two data sources stored on clouds and import them in AQUADVANCED® Water Networks: (i) ORTOMAT acoustic sensors / noise loggers (manufacturer: VON ROLL) and (ii) InflowSens™ high-frequency pressure sensors (manufacturer: Inflowmatix).	SUEZ
FR.3S.SA2.US01.UC.01	Dfn.003	Data	System stores collected measurements in the AQUADVANCED® Water Networks database	The system shall be able to automatically store collected measurements (see Dfn.002) in the AQUADVANCED® Water Networks database.	SUEZ
FR.3S.SA2.US01.UC.01	Nfn.004	Non-functional	Context of use	Dfn.002 and Dfn.003 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ

FR.3S.SA2.US01.UC.02	Fn.010	Functional	IT integrator configures the calculation context of water leaks detection	The IT integrator shall be able to configure, in a dialog box, the calculation context of water leaks detection. Default values are configured at the start of use, but they can be changed manually later by the IT integrator.	SUEZ
FR.3S.SA2.US01.UC.02	Fn.011	Functional	System calculates water leaks events detection	The system shall be able to automatically calculate water leaks events detection in the drinking water distribution network based on different hydraulic sensors (e.g. acoustic sensors, sectorization flow meters, automated meter reading, high-frequency pressure sensors). Calculations are performed in accordance with the calculation context defined in Fn.010.	SUEZ
FR.3S.SA2.US01.UC.02	Fn.012	Functional	System displays detected water leaks events	The system shall be able to display detected water leaks events (see Fn.011).	SUEZ
FR.3S.SA2.US01.UC.02	Nfn.005	Non-functional	Context of use	Fn.010 to Fn.012 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ

FR.3S.SA2.US01.UC.03	Fn.013	Functional	System improves decision making	The system shall be able to display the necessary and sufficient information to the operator, in a single graphical view, in order to decide whether or not there is a leak. This will improve and make the operator's decision suspecting a leak more reliable, and thus reduce the number of irrelevant events (i.e. not related to leak).	SUEZ
FR.3S.SA2.US01.UC.03	Nfn.006	Non-functional	Context of use	Fn.013 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ
FR.3S.SA2.US01.UC.04	Fn.014	Functional	IT integrator configures the calculation context of fast hydraulic transients detection	The IT integrator shall be able to configure, in a dialog box, the calculation context of fast hydraulic transients detection. Default values are configured at the start of use, but they can be changed manually later by the IT integrator.	SUEZ
FR.3S.SA2.US01.UC.04	Fn.015	Functional	System calculates fast hydraulic transients detection	The system shall be able to automatically calculate fast hydraulic transients detection in the drinking water distribution network based on high-frequency pressure sensors. Calculations are performed in accordance with the calculation context defined in Fn.014. Each detected event is	SUEZ

				characterized by different parameters (e.g. duration, intensity, spectrum(?), etc.).	
FR.3S.SA2.US01.UC.04	Fn.016	Functional	System displays detected fast hydraulic transients events	The system shall be able to display each detected fast hydraulic transients event on a georeferenced map or in a time-stamped events list (see Fn.015).	SUEZ
FR.3S.SA2.US01.UC.04	Fn.017	Functional	System identifies sensors having detected a same fast hydraulic transient event	The system shall be able to identify the sensors that have observed a same fast hydraulic transients event (see Fn.015).	SUEZ
FR.3S.SA2.US01.UC.04	Fn.018	Functional	System locates the cause of the detected fast hydraulic transient event	The system shall be able to locate the cause of the fast hydraulic transient event detected by several sensors (see Fn.017).	SUEZ
FR.3S.SA2.US01.UC.04	Nfn.007	Non-functional	Context of use	Fn.014 to Fn.018 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ
FR.3S.SA2.US02.UC.01	Dfn.004	Data	System collects water quality measurements from sensors	The system shall be able to automatically collect water quality measurements from water quality sensors and/or multi-parameter probes (at least PROTEUS probe prototypes) installed in	SUEZ

				the distribution network, and import them in AQUADVANCED® Water Networks.	
FR.3S.SA2.US02.UC.01	Dfn.005	Data	System stores collected water quality measurements in the AQUADVANCED® Water Networks database	The system shall be able to automatically store collected water quality measurements (see Dfn.004) in the AQUADVANCED® Water Networks database.	SUEZ
FR.3S.SA2.US02.UC.01	Nfn.008	Non-functional	Context of use	Dfn.004 and Dfn.005 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ
FR.3S.SA2.US02.UC.02	Fn.019	Functional	System displays water quality measurements	The system shall be able to display water quality measurements (see Dfn.004 and Dfn.005).	SUEZ
FR.3S.SA2.US02.UC.02	Fn.020	Functional	IT integrator configures the calculation context of abnormal water quality events detection	The IT integrator shall be able to configure, in a dialog box, the calculation context of abnormal water quality events detection. Default values are configured at the start of use, but they can be changed manually later by the IT integrator.	SUEZ
FR.3S.SA2.US02.UC.02	Fn.021	Functional	System calculates abnormal water quality events detection	The system shall be able to automatically calculate abnormal water quality events detection in the drinking water distribution network based on water quality sensors and/or multi-parameter probes	SUEZ

				(see Dfn.004 and Dfn.005). Calculations are performed in accordance with the calculation context defined in Fn.020.	
FR.3S.SA2.US02.UC.02	Fn.022	Functional	System displays detected abnormal water quality events	The system shall be able to display each detected abnormal water quality event on a georeferenced map or in a time-stamped events list (see Fn.021).	SUEZ
FR.3S.SA2.US02.UC.02	Nfn.009	Non-functional	Context of use	Fn.019 to Fn.022 shall be available in AQUAVANCED® Water Networks and compliant with the graphic identity (charter) of this software.	SUEZ

VI.5. System Requirements for Demo Case #3. Amsterdam (the Netherlands)

This section presents the list of requirements for the use cases of FIWARE-compliant WWTP optimisation application for the case of Amsterdam demo case.

Table 56: List of requirements for the "WWTP optimisation application"

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
NL.WNT.SA1.US01.UC01	Fn.001	Functional	Authentication procedure	The user shall be able to log on his personal profile using a password and a username.	Waternet
NL.WNT.SA1.US01.UC01	Fn.002	Functional	Request (near) real-time measurements	The user shall be able to request near real-time sensor or actuator data from the WWTP research lane.	Waternet
NL.WNT.SA1.US01.UC01	Fn.003	Functional	Request validation data	The user shall be able to select whether the (sampled) raw measurement data, the pre-processed validated measurement data or both will be presented.	Waternet

NL.WNT.SA1.US01.UC01	Fn.004	Functional	Request (near real-time) information for a time period of interest	The user shall be able to specify a past time point until the last available information (time period of interest).	Waternet
NL.WNT.SA1.US01.UC01	Fn.005	Functional	Selection of sensors	The user shall be able to select multiple points (sensors or actuators) for parallel near real-time monitoring.	Waternet
NL.WNT.SA1.US01.UC01	Fn.006	Functional	Download information	The user shall be able to download the near real-time information.	Waternet
NL.WNT.SA1.US01.UC01	D-Fn.001	Data	View requested data	The user shall be able to view validated and corrected measurement data, and the raw, possible sampled data.	Waternet
NL.WNT.SA1.US01.UC01	D-Fn.002	Data	Obtain requested data	The system shall obtain near real-time measurement data, pre-processed measurement data and metadata from the local database.	Waternet
NL.WNT.SA1.US01.UC01	Fn.009	Functional	Ease of interpretation	The system shall provide (meta) information about data anomalies, the detected sensor failures and information regarding the pre-processing of the presented data.	Waternet
NL.WNT.SA1.US01.UC01	Fn.010	Functional	Present information about the sensoring system	The system shall obtain information on the location of the sensors.	Waternet
NL.WNT.SA1.US01.UC01	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	Waternet
NL.WNT.SA1.US01.UC01	N-Fn.002	Non-Functional	Ease of use	The system shall have an easy-to-use design for the user.	Waternet
NL.WNT.SA1.US01.UC02	Fn.001	Functional	Authentication procedure	The user shall be able to log on his personal profile using a password and a username.	Waternet
NL.WNT.SA1.US01.UC02	Fn.002	Functional	Request (near) real-time information	The user shall be able to request process (variables) and (key) performance indicator data from the WWTP research lane.	Waternet
NL.WNT.SA1.US01.UC02	D-Fn.001	Data	Request (near real-time) information for a	The user shall be able to specify a time horizon up until the current time	Waternet

			time period of interest	instant (time period of interest).	
NL.WNT.SA1.US01.UC02	D-Fn.002	Data	View requested information	The user shall be able to view the information.	Waternet
NL.WNT.SA1.US01.UC02	Fn.003	Functional	Download information	The user shall be able to download the information.	Waternet
NL.WNT.SA1.US01.UC02	Fn.004	Functional	Access to variables and performance indicators	The system shall obtain (near real-time) data on process variables and (key) performance indicators from the local database.	Waternet
NL.WNT.SA1.US01.UC02	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	Waternet
NL.WNT.SA1.US01.UC02	N-Fn.002	Non-Functional	Ease of use	The system shall have an easy-to-use design for the user.	Waternet
NL.WNT.SA1.US01.UC03	Fn.001	Functional	Authentication procedure	The user shall be able to log on his personal profile using a password and a username.	Waternet
NL.WNT.SA1.US01.UC03	Fn.002	Functional	Request forecasted information	The user shall be able to request short-term forecasts of process (variables) and (key) performance indicators from the WWTP research lane.	Waternet
NL.WNT.SA1.US01.UC03	D-Fn.001	Data	Selection of variables	The user shall be able to select the process variable or (key) performance indicators of interest in the dashboard/conveyance system.	Waternet
NL.WNT.SA1.US01.UC03	D-Fn.002	Data	View requested information	The user shall be able to view the information.	Waternet
NL.WNT.SA1.US01.UC03	Fn.003	Functional	Download information	The user shall be able to download the information.	Waternet
NL.WNT.SA1.US01.UC03	Fn.004	Functional	Access to variables and performance indicators	The system shall obtain forecasted data on process variables and (key) performance indicators from the local (legacy) database.	Waternet
NL.WNT.SA1.US01.UC03	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	Waternet
NL.WNT.SA1.US01.UC03	N-Fn.002	Non-Functional	Ease of use	The system shall have an easy-to-use design for the user.	Waternet

NL.WNT.SA1.US01.UC04	Fn.001	Functional	Authentication procedure	The user shall be able to log on his personal profile using a password and a username.	Waternet
NL.WNT.SA1.US01.UC04	Fn.002	Functional	Request control settings information	The user shall be able to request control settings of the WWTP regarding criteria for greenhouse emissions, energy costs and water quality.	Waternet
NL.WNT.SA1.US01.UC04	D-Fn.001	Data	Selection of controller settings	The user shall be able to select the control parameters of interest in the dashboard/control system.	Waternet
NL.WNT.SA1.US01.UC04	D-Fn.002	Data	View requested information	The user shall be able to view the information.	Waternet
NL.WNT.SA1.US01.UC04	Fn.003	Functional	Change control settings	The user shall be able to change control settings.	Waternet
NL.WNT.SA1.US01.UC04	Fn.004	Functional	Download information	The user shall be able to download the information.	Waternet
NL.WNT.SA1.US01.UC04	Fn.005	Functional	Access to control settings information	The system shall obtain control settings data from the local (legacy) database.	Waternet
NL.WNT.SA1.US01.UC04	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	Waternet
NL.WNT.SA1.US01.UC04	N-Fn.002	Non-Functional	Ease of use	The system shall have an easy-to-use design for the user.	Waternet

VI.6. System Requirements for Demo Case #4. Great Torrington (UK)

In Great Torrington demo case, FIWARE-compliant applications for smart metering systems are going to be developed, targeting both the utility and consumer domain (see Section II.4). The list of requirements for utility domain are presented in Section VI.6.i, while those for consumer domain in Section VI.6.ii.

VI.6.i. Water utility domain

Table 57: List of requirements for the application of utility domain

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
UK.SWW.SA1.US01.UC01	Fn. 001	Functional	User (Water Utility) logs in	The user shall be able to log into the application using their Microsoft AD account (or an application specific username and password)	SWW

UK.SWW.SA1.US01.UC01	Dfn.n 001	Data	User (Water Utility) views Smart Meter (AMI) / Temetra data	The user shall be presented an 'average consumption' graph for Smart Meter (AMI) / Temetra	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 002	Data	User (Water Utility) views AMR meter data	The user shall be presented with an 'average consumption' graph for AMR meter	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 003	Data	User (Water Utility) views Standard meters data	The user shall be presented with an 'average consumption' graph for Standard meters	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 004	Data	User (Water Utility) views modelled unmetered data	The user shall be presented with an 'average consumption' graph for Unmetered consumption (modelled)	SWW
UK.SWW.SA1.US01.UC01	Fn. 002	Functional	System calculates consumption for Smart Meter (AMI) / Temetra data	The system shall calculate an average consumption for the current month and previous 5 months using Smart meter data (e.g. from Great Torrington)	SWW
UK.SWW.SA1.US01.UC01	Fn. 003	Functional	System calculates consumption for AMR Meters	The system shall calculate an average consumption for the current month and previous 5 months using 6 monthly meter reads from AMR Meters (data held in billing system: RAPID)	SWW
UK.SWW.SA1.US01.UC01	Fn. 004	Functional	System calculates consumption data for standard meters	The system shall calculate an average consumption for the current month and previous 5 months using 6 monthly meter reads from standard Meters (data held in billing system: RAPID)	SWW
UK.SWW.SA1.US01.UC01	Fn. 005	Functional	System models consumption for unmetered customers	The system shall calculate a modelled consumption for unmetered	SWW

				customers which reflects seasonality	
UK.SWW.SA1.US02.UC01, UK.SWW.SA1.US02.UC02	Dfn.n 005	Data	User (Water Utility) view leak alarms	The user shall be presented with a tabular and map presentation of leak alarms from smart meters	SWW
UK.SWW.SA1.US02.UC01	Fn. 006	Functional	System processes leak alarms	The system shall detect leak alarms using ‘leak alarm’ data provided by the smart meters	SWW
UK.SWW.SA1.US02.UC02	Fn. 007	Functional	System analyses data for 'suspect' leaks	The system shall detect leak alarms by analysing the data to detect constant low flows	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 006	Data	User (Water Utility) selects area	The user shall be able to select different smart meter area (e.g. great Torrington, Cranbrook)	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 007	Data	User (Water Utility) views consumption data map	The user shall be presented with a map showing all smart metered customers in the area. Households are coloured by their consumption (low, medium, high).	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 008	Data	User (Water Utility) views historic consumption	The user shall be able to click on household to view historic consumption in a graph	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 009	Data	System retrieves consumption data	The system shall retrieve data for all households which have been tagged with the area (e.g. Great Torrington)	SWW
UK.SWW.SA1.US01.UC01	Fn. 008	Functional	System categorises users by consumption	The system shall calculate whether households are low, medium or high users based on the cohort (e.g. through clustering) OR based against company defined threshold (e.g. 400L per day = medium user)	SWW

UK.SWW.SA1.US01.UC01	Dfn.n 010	Data	System retrieves consumption data for any customer	The system shall retrieve consumption data for any customer	SWW
UK.SWW.SA1.US01.UC01	Dfn.n 009	Functional	User (Water Utility) views customers grouped by consumption behaviour	The user shall be presented with a three dimensional graph showing the output of a clustering algorithm (e.g. K-means) which partitions customers into groups based on similar consumption behaviour. For example, one group may be users which use a lot of water in the summer week because they have very large gardens. Graph also highlights customers which cannot be grouped (e.g. because they're consumption is much higher than any other group)	SWW
UK.SWW.SA1.US02.UC03	Dfn.n 011	Data	User views rainfall data for smart metered area	The user shall be able to view rainfall data for the smart meter area (e.g. great Torrington, Cranbrook)	SWW
UK.SWW.SA1.US02.UC03	Dfn.n 012	Data	User (Water Utility) views temperature data for smart metered area	The user shall be able to view temperature data for smart meter area (e.g. great Torrington, Cranbrook)	SWW
UK.SWW.SA1.US01.UC01	Fn. 010	Functional	Systems clusters customers by consumption behaviour	The system shall use a clustering algorithm to group customers based on their consumption behaviour. This is updated regularly (e.g. weekly)	SWW
UK.SWW.SA1.US02.UC03	Fn. 011	Functional	System queries rainfall API	The system shall query an open source API e.g. https://environment.data.gov.uk/flood-monitoring/doc/rainfall to retrieve rainfall data	SWW

UK.SWW.SA1.US02.UC03	Fn. 012	Functional	System queries temperature API	The system shall query an open source API e.g. https://openweathermap.org/API to retrieve temperature data	SWW
UK.SWW.SA1.US01.UC01	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	SWW
UK.SWW.SA1.US01.UC01	N-Fn.002	Non-Functional	Ease of use	The system shall have easy-to-use design for the user.	SWW
UK.SWW.SA1.US01.UC01	N-Fn.003	Non-Functional	Branding	The system will be branded in SWW colour schemes	SWW
UK.SWW.SA1.US01.UC01	N-Fn.004	Non-Functional	Compatibility	The systems shall have user interface which must be available in Microsoft edge and chrome (at the least)	SWW

VI.6.ii. Consumer domain

Table 58: List of requirements for the application of consumer domain

Use Case ID	Req. ID	Req. Type	Requirement Short Description	Requirement Details	Demo Case
UK.SWW.SA2.US01.UC01	Fn. 013	Functional	User (customer) logs into smartphone app	The user shall be able to log into the smart phone application	SWW
UK.SWW.SA2.US01.UC01	Dfn.n 013	Data	User (customer) views consumption (summary)	The user shall be presented with 3 figures; yesterday's consumption, average consumption, and the average daily cost	SWW
UK.SWW.SA2.US01.UC01	Fn. 014	Functional	System calculates users average consumption	The system shall retrieve the users consumption for the previous day	SWW
UK.SWW.SA2.US01.UC01	Fn. 015	Functional	System calculates users average consumption	The system shall calculate the users average consumption	SWW
UK.SWW.SA2.US01.UC01	Fn. 016	Functional	System calculates users average consumption	The system shall calculate an estimated daily cost based on company water tariff	SWW
UK.SWW.SA2.US02.UC01, UK.SWW.SA2.US01.UC01	Dfn.n 014	Data	User (customer) views their historic consumption	The user shall be presented with a graph showing their historic consumption.	SWW

UK.SWW.SA2.US02.UC01, UK.SWW.SA2.US01.UC01	Fn. 017	Functional	User (customer) views their historic consumption	The user shall be able to see consumption for last week's, last months or last 6 months. The graph shows a buffer around the users' consumption which represents the average of other users' consumptions in the region. For example, if the users' consumption was 300 Litres, a buffer might stretch between 260 litres (lowest user in the region) to 380 litres (highest user in the region). User can easily compare their consumption to others.	SWW
UK.SWW.SA2.US02.UC01, UK.SWW.SA2.US01.UC01	Dfn.n 015	Data	Systems retrieve customers consumption data	The system shall retrieve users consumption for chosen date range	SWW
UK.SWW.SA2.US02.UC01, UK.SWW.SA2.US01.UC01	Fn. 018	Functional	Systems calculates comparatory consumption data	The system shall calculate the lowest and highest (or range of) consumption for the users region (e.g. Great Torrington)	SWW
UK.SWW.SA2.US02.UC01	Fn. 019	Functional	User (customer) sets consumption targets	The user shall be able to set a daily consumption target	SWW
UK.SWW.SA2.US02.UC01	Fn. 020	Functional	User (customer) sets consumption targets	The shall be notified when yesterday's consumption was higher than the target	SWW
UK.SWW.SA2.US02.UC01	Fn. 021	Functional	User (customer) sets consumption targets	The user shall be able to can switch off notifications via the app	SWW
UK.SWW.SA2.US02.UC01	Fn. 022	Functional	User (customer) sets consumption targets	The user shall be able to view a graphic showing the percentage they were over or under from their target for the previous day	SWW
UK.SWW.SA2.US02.UC01	Fn. 023	Functional	System changes users consumption targets	The system shall provide a mechanism for user to add, update and remove daily consumption targets	SWW
UK.SWW.SA2.US02.UC01	Fn. 024	Functional	Systems notifies users of high consumption	The system shall generate notifications for the user (e.g. for	SWW

				consumption higher than target), unless they have turned them off	
UK.SWW.SA2.US02.UC01	Fn. 025	Functional	System calculates user performance against consumption target	The system shall calculate the percentage difference between yesterday's consumption and the user's target.	SWW
UK.SWW.SA2.US01.UC01	N-Fn.001	Non-Functional	Responsiveness	The system shall display requested data in reasonable time.	SWW
UK.SWW.SA2.US01.UC01	N-Fn.002	Non-Functional	Ease of use	The system shall have easy-to-use design for the user.	SWW
UK.SWW.SA2.US01.UC01	N-Fn.003	Non-Functional	Branding	The system will be branded in SWW colour schemes	SWW
UK.SWW.SA2.US01.UC01	N-Fn.005	Non-Functional	Compatibility	The system shall be compatible with Android	SWW

VII. EU added value

We understand the EU added value for a project to be the value resulting from the project because it is performed as a collaboration between different Member States at the EU level, which is additional to the value that would have been created by individual Member States acting alone. In this respect, this document, which essentially describes the first step towards the development of Fiware-compliant services and devices for the water sector (i.e., the identification and collection of use cases and system requirements for the applications that are to be developed), includes a series of EU added value propositions:

- It increases the visibility and dissemination of FIWARE, as a key vehicle to support interoperability and seamless data exchange, both within water utility's operational staff and other water stakeholders in the framework of workshops organised at each demo case. The participants at each demo case had the opportunity to become aware of the Fiware-compliant water services that are being developed within the project, further to those concerning the specific demo case, sharing good practices and experiences across the EU.
- The identification of end-user and system requirements, for applications that address different water-related issues (drinking water, raw-water, wastewater), based on a common standard framework (the use cases), is a transferable paradigm establishing a common language between different actors from different water sectors, and is a key pre-requisite towards the harmonisation of the digitalisation of water services at European and global level.
- Furthermore, the use cases and system requirements identified can serve as the basis for the development of new applications by other EU service providers for other EU water utilities, accelerating the adoption of digital technologies for water management and increasing the water and environmental efficiency of the European Water Industry and the competitiveness of European SMEs.

VIII. Conclusion

This deliverable describes the use cases and system requirements of the FIWARE-compliant Smart Water Applications that will be developed in the framework of the Fiware4Project, aiming to address the identified challenges at the four Demo Cases. The identification procedure for both use cases and system requirements was evolved through 3 workshops, organised between local utility and local research partner at each demo case location. To establish a common identification procedure and support the description of use cases and requirements in a standardised way across all four demo cases, guide documents and templates were employed.

The above procedure resulted in the identification and description of 32 use cases for the FIWARE-compliant Smart Water Applications at all four demo cases. Specifically, this deliverable summarises: 13 use cases for applications of Athens demo case, 9 use cases for applications of Cannes demo case, 4 use cases for applications of Amsterdam demo case and 6 use cases for applications of Great Torrington demo case.

The following table gives an overview of the number of use cases per Demo Case, indicative examples and the type of water domain.

Demo Case	Water Domain	Use cases	Indicative Examples
DC#1: Athens (Greece)	**Raw water** conveyance and **drinking water** supply	13	Water quantity routing • Obtain real-time information on water flow • Receive warnings about unusual flow conditions • Obtain information on water losses Water quality early warning • Obtain real-time information about water quality • Receive information and warnings about unusual quality events
DC#2: Cannes (France)	**Drinking water** distribution networks **Raw water** availability and demand	9	Production and transport • Forecast water availability during summertime • Forecast water demand Distribution • Collect data • Detect water leaks • Detect fast hydraulic transients
DC#3: Amsterdam (the Netherlands)	**Wastewater** treatment plant operation	4	• Obtain near real-time validated sensor data of the WWTP research lane • Understand the performance of the WWTP research lane • Short-term forecast the process behaviour and performance of the WWTP research lane
DC#4:Gr. Torrington (UK)	**Drinking water** consumption at household and utility (network) level	6	• Obtain water consumption data from smart metered households • Leak alarms from smart meters

For each use case, the corresponding list of requirements is composed. The study of 32 use cases, we identify in total 213 requirements covering the functional, data, and non-functional aspects of the system. The list of use cases and system requirements aim to support the subsequent activities of the project and especially the design of the Fiware4Water system architecture (WP2), the development of Smart Applications (WP3) and the demonstration of the developed applications (WP4).

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Annex A: Guide and Template for use cases identification

This document was composed and distributed to the partners of F4W aiming to facilitate and guide the workshops at each demo case between the local utility and the local research partner, establishing a common use case identification procedure across the four demo cases.

The 1st workshop between the local research partner and the utility at each Demo Case is dedicated to the initial derivation and collection of user stories (High-level use cases). This process aims to explore:

1. What are the challenges that utilities want to address with the applications and tools which are to be developed in the framework of FIWARE4Water?
2. What is the **current state of play** of the **legacy** systems and how these can be exploited to facilitate the development of new tools? More specifically, these concern:
    a. Existing datasets
    b. Existing sensors and actuators that enable dataflow
    c. Existing SCADA systems and protocols
3. What are the desired **functionalities** of utilities for the new applications and tools to have?
4. What **new** sensors and systems should be deployed to enable the development and operation of new tools?

In practice, the answers to the above questions are standardised via a template for user stories (High-level use cases) and use cases – provided below.

In order to further facilitate this procedure and support the partners participated at each workshop, we recommend the following steps to be followed before, during and after the workshops:

Before 1st workshop (Preparatory actions):

1. Both local partners should read and understand the template as well as the relevant example from a similar project in order to have a clear picture of what is expected as the final outcome of this process.
2. Local utility should have conducted a preliminary screening on the existing systems and technologies (e.g., sensors).
3. Local utility should have considered a preliminary 'wish list' regarding key functionalities of the new tools addressing their challenges.
4. Local utility should have conducted a preliminary screening on which new sensors and other technologies, currently missing, will be deployed in order to enable the development of new tools.

During 1st workshop:

The focus of the first workshop is **the derivation of a set of the desired high-level use cases (user stories)**, spelling out the functionalities of each tool/application that is to be developed from the user perspective (not getting into algorithmic issues). The aim is to complete the template given in Table 1 for each high-level use case recognized.

For each use case the partners need to discuss:

1. What is the name of the user story (**field a in Table 1**)?
2. What is the domain of the user story (**field b in Table 1**)?
3. What is the goal addressed by the user story (**field c in Table 1**)?
4. Who participates in the user story (**field d in Table 1**)?
5. What this functionality does (**field e in Table 1**), at least a sort description?
6. What are the required data (**field f in Table 1**) to enable the implementation of this user story?
7. What aspects may restrict or constrain this user story to be implemented (**field g in Table 1**)?

To the extent possible, **the above user stories should be broken down into use cases** (template in Table 2) that provides a more detailed description of the systems' functionalities.

At the end of the 1st workshop, the local research partner should have a clear picture on the main functionalities (at least a high high-level) of the tools (**from a user perspective**) that are to be developed as well as on relevant existing data, technologies and legacy systems.

After 1st workshop:

1. Based on the outcomes of the workshop and the above information, the local research partner should re-examine the feasibility of the shortlisted user stories and observe any weaknesses or obstacles on their development.
2. Next, the local research partner, for each user story, should compile a list of use cases that gives in more detail the functionalities of the application
3. For each use case derive, the local research pattern should complete the template of Table 2 in order to provide all the appropriate information.
4. The revised list of user stories and the derive list of use cases along with the completed tables will be further discussed with the local utility in the next workshop.

Table 1 – User story (High-level use case) template

a. Unique ID and user story name	User story reference number and name the user story from the perspective of the actors' goals
b. Domain	Each user story belongs to a domain, which corresponds to a business environment
c. Goals	Stakeholder's goals addressed by the user story
d. Stakeholders	Actor that initiates this user story and all other actors who participate in this user story
e. Description	Verbal description of the user story regarding the goals to be achieved
f. Data source	Description of the source of the data required for this user story

g. Constraints	Aspects that might condition the user story

Table 2 – Use case template

h. Unique ID and use case name	Use case reference number and name the use case from the perspective of the actors' goals
i. Domain	Each use case belongs to a domain, which corresponds to a business environment
j. Goals	Stakeholder's goals addressed by the use case
k. Actors	Actor that initiates this use case and all other actors who participate in this use case
l. Description	Verbal description of the use case regarding the goals to be achieved
m. Pre-condition	Conditions that must be met for use case to start
n. Post-condition	Conditions that must be met for use case to terminate successfully
o. Data source	Description of the source of the data required for this use case
p. Trigger	The event or sequence of events that initiate the use case
q. Constraints	Aspects that might condition the use case
r. Main flow	List of interactions between the actors and the system
s. Alternative flow	Any variations in the main flow of a use case (on the manner or mode in which it may happen)
t. Issues	List of issues that remain to be resolved
u. Relationship with other use cases	List of use cases that are related

Annex B: Notes from Cannes Workshops

This document was composed and distributed to the partners of F4W aiming to facilitate and guide the identification of system requirements, establishing a common procedure across the four demo cases.

Having completed the 2nd workshop between the local research partner and the utility at each Demo Case, the next step consists in deriving the system requirements for the tools to be developed.

The derivation of system requirements supports the more in-depth understanding and description of the functionalities of the systems as initially described via the lower-level use cases. With respect to service (and product) development, a requirement describes an individual, specifically documented need that this service (or product) has to fulfil.

Based on the functionalities described via lower-level use cases, the specification of requirements is based on the following three types:

- **Functional requirements**: Things the tool must do, that source from user goals.
- **Non-functional requirements**: Qualities and properties that the system must have, e.g. performance, reliability, fault tolerance, frequency, priority.
- **Data requirements**: It covers aspects such as required data for the system and access to information.

Before the 3rd workshop, each local research partner should identify and describe the above three types of requirements for **each individual lower-level use case (functionality of the system)**. This will be conducted via a standardised procedure in order to ensure a common language and form of requirements across the 4 demo cases. Specifically, for each lower-level use case **a verbal description** of the requirements will be initially performed. This description will be based on the following two statements:

- The <*stakeholder/user*> shall be able to <*capability of the system*>

  Example: The user shall be able to request real-time water flow data from the sensors in the conveyance system.

- The <*system*> shall be able to <*function*>

  Example: The system shall be able to obtain real-time flow data from the local database.

As shown in the following example, the derive requirements should describe the functionalities of the system at the maximum possible level of detail (to the extent that the current conception on the tools to be developed permits).

After the completion of this stage, the description of system requirements **for each use case** should be standardised in the form of a spreadsheet that contains the following fields:

- **Use Case ID:** Providing the use case(s) from which the requirement is derived, is useful for sorting requirements with respect to different functionalities of the system.
- **Requirement ID:** It is the unique identifier that specifies the enumeration, type of requirement, possibly includes traces from its source e.g. use case number.

- **Requirements Type:** It is useful to specify the nature of the requirement, e.g. Functional, Non-Functional, Data.
- **Requirement Short Description:** Short title for the requirement, enables a brief understanding of the content.
- **Requirement Details:** Objective is to capture stakeholder wishes, by describing the intent of the requirement. It should be written in plain language, and should not have open-ended statements.
- **Demo Case:** Refers to the demo case that raised the requirement.

A screenshot of this spreadsheet template that includes the above fields is given next.

Use Case ID	Req. ID: Fn.n, Nfn.n or Dfn.n	Req. Type: Functional, Non-Functional or Data	Requirement Short Description	Requirement Details	Demo Case
WP1.GR1.EYDAP.US01.UC01	Fn.001	Functional	Authentication Procedure	The user shall be able to log on his personal profile using a password and a username.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.002	Functional	Request real-time information	The user shall be able to request real-time water flow data from the sensors in the conveyance system.	EYDAP
WP1.GR1.EYDAP.US01.UC01	Fn.003	Functional	Selection of sensors	The user shall be able to select the point (sensor) of interest in the conveyance system.	EYDAP

<u>Some instructions for the spreadsheet</u>:

- The final version will comprise the requirements from all use cases into one sheet (not sheet per use case)
- In the case that the same system requirement appears in multiple use cases (e.g., the general requirement “The user shall be able to print the information”), then it is inserted only once in the spreadsheet and in the corresponding “Use Case ID” field all the relevant use cases are reported (e.g., “WP1.GR1.EYDAP.US01.UC01, WP1.GR1.EYDAP.US01.UC02, WP1.GR1.EYDAP.US01.UC06”).
- In column “Requirement ID” a continuous numbering is adopted for the functional (e.g., Fn.001, Fn.002 etc.), non-functional (e.g., N-Fn.001, N-Fn.002 etc.) and data requirements (D-Fn.001, D-Fn.002 etc.).
- The column “Requirement Short Description” provides a short title for the requirement, while the column “Requirement Detail” essentially includes the entire (but also short) verbal description.